SCIENCE EDUCATION

THE OFFICIAL ORGAN OF

The National Association for Research in Science Teaching
The National Council on Elementary Science
The Association of Science Teachers of the Middle States

VOLUME 30
NUMBER 1

FEBRUARY, 1946

Published by Science Education, Incorporated

These Books Make Science *Fascinating*

EVERYDAY SCIENCE
Caldwell-Curtis

What your pupils need to know about general science to better understand and enjoy life. Everyday-life applications of science are emphasized; probable postwar scientific developments discussed.

THE PHYSICAL SCIENCES
Eby-Waugh-Welch-Buckingham

Essentials of physics, chemistry, geology and astronomy presented in clear, interesting style. Emphasizes topics like radio, aeronautics, Diesel and gas engines, meteorology, science's applications to public health and home.

EVERYDAY BIOLOGY
Curtis-Caldwell-Sherman

How biology plays a vital part in our lives—how it relates to health, disease, food, nutrition, conservation and recreation. Stresses fundamentals, and social and economic phases most important today.

LIVING CHEMISTRY
Ahrens-Bush-Easley

Has practical, everyday problems pupils are interested in. Problems relating to life at home, in community and industry. Flexibly organized; wealth of orientation material and activities.

Ask for Full Information on These Books

Boston 17 New York 11 Chicago 16 Atlanta 3
Dallas 1 Columbus 16 San Francisco 5 Toronto 5

1867 GINN AND COMPANY TEXTBOOKS OF DISTINCTION

VISUAL AIDS *for* BIOLOGY

"MEDICHROMES" KODACHROMES

For several years we have been developing an extensive series of MEDICHROMES *—2 x 2" Kodachromes covering the fields of normal and pathological histology, clinical medicine and nursing. We now have some 5,000 subjects ready for distribution. Of these there are a number of slides that will be of interest to you in your teaching, for example, those on mitosis, cell types and some of the simpler histology slides.

If you are located in or near New York City, please come in and examine the collection, or literature will be sent on request . . . please write giving us your institutional affiliation.

* Trade Mark Regd. U. S. Pat. Off.

CLAY-ADAMS CO INC.
44 EAST 23rd STREET, NEW YORK 10, N. Y.

Announcing . . .
a new visual aid
The
ADEL COLOR
SLIDE VIEWER

Features . . .

1. Home illuminated with a 6' electrical cord. The switch controls self-contained flashlight batteries for portable use. Standard bulbs make replacement easy and inexpensive.

2. Shows all types of 2 x 2" slides—paper, metal or glass mounted.

3. Two lens optical system magnifies without distortion. No reflected light to create fuzzy image.

4. Each color-slide positions easily—and up to 20 will feed in rotation to collect in compartment from which they are easily removed.

5. Weighs less than 3 pounds with a durable long-lasting plastic case. Molded feet protect furniture. No moving parts to wear out.

A-1537 . . . . . $19.75

Patronize our advertisers. Tell them that you saw their advertisement in SCIENCE EDUCATION

General
Japan

SCIENCE EDUCATION

Formerly GENERAL SCIENCE QUARTERLY

SERVING TEACHERS IN ELEMENTARY SCHOOLS,
JUNIOR AND SENIOR HIGH SCHOOLS, COLLEGES,
AND PROFESSIONAL SCHOOLS FOR TEACHERS

VOLUME 30 FEBRUARY, 1946 NUMBER 1

CONTENTS

Introducing the Contributors 6

The Atomic Bomb and the Science Teacher ..... *Phillip Morrison* 7

"Life" and "Fortune" Magazines as Sources of Science Pictures *William F. Goins, Jr.* 10

"An Investigation of the Director or Supervisor of Science in the Public Schools ..... *Robert H. Carleton* 11

How Is Difficulty of Subject Matter a Factor Affecting Learning General Science? ..... *Victor C. Smith* 19

Possible Health Teaching Objectives and Evaluation of Their Attainment *Bernhard J. Stern* 24

Changing Concepts in Education ..... *Blanche A. Schindelman* 35

A Great Scientific "Working Party" ..... *Ritchie Calder* 36

Science Reading Materials for Pupils and Teachers ..... *Clarence M. Pruitt* 39

Book Reviews 50

Abstracts 55

Copyright, 1946, by SCIENCE EDUCATION, INCORPORATED

(The Contents of SCIENCE EDUCATION are indexed in the Education Index)

INTRODUCING THE CONTRIBUTORS

DR. PHILLIP MORRISON ("The Atomic Bomb and the Science Teacher") is a former member of the Physics Department at the University of Illinois and member-elect of the Physics Department at Cornell University. He has been associated with the Manhattan Project since February 1943 and stationed at Los Alamos, New Mexico. Present at the July 16th atomic bomb demonstration, he was later member of a small group of physicists working on the final bomb preparation on the island of Tinian in the Mariannas. Later he was one of the group who inspected the atomic bomb damage at Hiroshima and Nagasaka. At present he is taking part in studying the physiological effects on the skin tissues of 60 Japanese victims of the bomb.

WILLIAM F. GOINS, JR. ("Life and Fortune Magazines as Sources of Science Pictures") has been instructor in chemistry and physical science for the past four years at Hampton Institute. Previously he taught science and mathematics in high schools in Maryland and Virginia.

R. H. CARLETON ("An Investigation of the Director or Supervsior of Science in the Public Schools") is Chairman of the Science Department in Summit High School, Summit, N. J., and he has been an instructor in physical science at New York University. He is the author or co-author of a number of publications in the fields of secondary-school chemistry, physics, and physical sciences. At this time Mr. Carleton is Eastern States Vice-President of the National Science Teachers Association and Secretary-Treasurer of the New Jersey Science Teachers Association.

Dr. Victor C. Smith ("How Is Difficulty of Subject Matter a Factor Affecting Learning in General Science") has been head of the science department at the Ramsay Junior High School, Minneapolis, since 1932. He is well known to many science teachers through his co-authorship of *Science in Daily Life* and *Science in Modern Life Series,* and also through several articles that have been published in various magazines.

BERNHARD J. STERN ("Possible Health Teaching Objectives and Evaluation of Their Attainment") contributed to the April issue and was introduced to our readers at that time.

MRS. BLANCHE A. SCHINDELMAN ("Changing Concepts in Education") teaches Biology and Science in the Elizabeth Irwin High School of the Little Red School House, a progressive private school in New York City.

RITCHIE CALDER ("A Great Scientific Working Party") is Science Editor of the *London News Chronicle.* He has been long concerned with the impact of scientific discovery on human affairs. He anticipated the setting up of the U.N.E.S.C.O., in what the *New York Times* described as "the Calder Plan" Two of his scientific book publications include: *The Birth of the Future* and *Conquest of Suffering.*

CLARENCE M. PRUITT ("Science Reading Materials for Pupils and Teachers") needs no introduction to readers of *Science Education.* During the past two years he has been instructor in Physics and Geography in the A.S.T.R. unit at the University of Illinois.

SCIENCE EDUCATION

VOLUME 30 FEBRUARY, 1946 NUMBER 1

THE ATOMIC BOMB AND THE TEACHER OF SCIENCE

PHILLIP MORRISON

No advance of science within our times has caused such widespread concern as the recent release of large quantities of nuclear energy. The bombs which laid waste Nagasaki and Hiroshima shook the thinking of men and women, especially in our country which made the bombs, beyond precedent. Persons—the author admits to being an example—who have led the quiet and unspectacular life of teachers of science find themselves in the grip of a sobering responsibility. We made the bomb, and we must tell what it means. The physicists and chemists from the universities who have assumed the role of instructing the public at large are undertaking their largest job. They need the assistance of that large community of teachers of science who have had no special connection with the development of atomic armament. Not since the Renaissance, when the very act of inquiry was in need of defense, not since the contentious time of Huxley and Darwin, when the results of inquiry were denied credence, have we who follow the way of science had so grave a crisis. And few times before in our democracy have individual citizens had as great need to speak up, to tell what they know, and to think clearly about the meaning of their special knowledge.

What the science teacher needs do, and what he is peculiarly fitted to do, is clear. Above all, the facts of the atomic bomb, the facts of the release of nuclear energy, need the widest dissemination. The famous Smyth report is a mine of information. But its ores need refining before the public or the student can understand them. In and out the school the educator in science must try to make comprehensible the fascinating story of the winning of nuclear energy in our time. There is no comparable experience in science. The unity of techniques, the passing from abstract theory and laboratory-scale devices to the great plants of Oak Ridge and Hanford provide an opportunity to expose not only the connection of all the natural sciences, but also the interdependence and yet the difference between science and technology. Abundant radioactivity and its meaning for medicine and general biology, plutonium and isotope separation and what they mean to chemistry, the chain reaction and high neutron flux and the whole new physics of fission on which they rest—these things touch every field of science and leave it changed. Even more important facts, those on which the military importance of the bomb rests, its unique destructiveness, its potential cheapness, the reasons why there is no specific defense—such facts as these are important not only for the student of science but for everyone who lives in a house that can be blown down.

There is more. One can mention two less concrete but no less real points which demand clear and repeated discussion. First is the tradition of science. What has

it been all about? There is a latent but growing feeling that science is somehow turning evil or blind. The people have the right to ask why must we do research if the outcome is the ruin of Hiroshima and its hundred thousand blackened corpses. Nor can scientifically-minded persons ignore this query. It must be answered and answered in terms of the long history of science itself. We must understand this history, and we must also understand what new conditions in our day make a newer answer necessary. The smashing of the cyclotrons in Japan, the common illusion that special secrecy can be imposed on the nature of the physical world, the increased drive toward a narrow nationalism in science are public questions which must be met by citizens who understand what science means.

The field of science is perhaps the one section of endeavor which has grown to depend on change and on novelty. The growth of science through new discovery while yet maintaining continuity with past knowledge is familiar to all who have studied any field of science. It is this kind of understanding of change, this sort of realization that new times come, bringing new problems which must be approached without fear, which is the special possession of science. It is up to us to show the non-scientific that a similar understanding must come in society at large. We must learn how to modify the relations among men and among nations to make them workable in the face of scientific innovation. In the years which lie before us, years in which the old institution of war has taken on a new and intolerable meaning, we must seek that change which will end the threat of war. The scientific man has a special responsibility here, not indeed to solve the problem by himself, but to indicate that spirit and those conditions which have made success in the domain of science possible.

Sound lessons in the art of teaching have been learned in the course of the development of the bomb and the public discussion which has grown around it. It is worth while in this connection to tell a story. At the laboratory in Los Alamos very much attention was given to the study of the physical effects of an atomic bomb. It was necessary to know what increased military effect could be expected from the enormous energy release of a single bomb. For example, the area of damage caused by the blast wave from an explosive bomb does not increase proportionately to the mass of explosive detonated, but less rapidly. In fact, the area damaged per ton of high explosive decreases as the weight of the individual bomb increases. It was important to estimate such effects for the region of the ten-thousand-ton explosion of an atomic bomb. Grim studies had to be made of the effect of the heat and of the radiation from the bomb against buildings and against personnel. All this was done by calculation, by small-scale experiment, and by study of the results of actual bombing in England and on the Continent. When the test explosion was set off in the desert in New Mexico, we had all read detailed and quantitative reports of what could be expected to happen. We were well prepared. And the reports proved surprisingly accurate. The whole phenomenon proceeded according to plan. But we found that our own understanding had been insufficient. In spite of knowing the figures and the facts, we had not realized their meaning. Only the concrete demonstration was convincing. The information which had been clearly presented in graphs and formulae had meaning for us only when we saw that terrible light. No one who was present remained unchanged by the experience. The leading authority on physical effects spoke the next day to a group of us at Los Alamos. He was a war-wise British scientist. He confessed that, even though his predictions were veri-

fied, his understanding of what this weapon would mean had not been real until he saw the explosion itself. He and I were in Hiroshima; and we agreed that even the desert demonstration had not made us realize what incredible damage the device would cause in a city of men. It is concrete, specific example which is the best teacher. For this reason the photographs and the eye-witness accounts of the damage in Japan have been so generally circulated. It is just in proportion to the specific and real quality of illustration that understanding comes. Every teacher of science knows this; it is the best justification for laboratory methods of instruction. But we had painfully to learn the lesson again in this new way.

An excellent example of the sort of public issue which demands scientific analysis is the rather unthinking hope for a defense against the atomic bomb. The position taken hastily by many is based on the assertion that "to every offensive weapon, there is found in time a defense." It is interesting to look more closely at this position. What is the defense against a block-buster? Clearly, either to shoot down the bomber which launches it while it is still far from the target city, or to build the city more strongly. The atomic bomb encounters the same defense. Only in the case of this new weapon even one bomb successfully launched may destroy a city; and the strengthening of cities to resist the force of the atomic bomb is completely bizarre as a practical measure. The nature of the atomic explosion comes into question here. Perhaps some ray may be found which will detonate the bomb while yet far away. Irresponsible sources in the press have even suggested that such a magical defense exists. A simple inquiry into the facts of how a chain reaction starts and what it is, will dispel such illusions. The "ray" is an example of a much more serious and general feeling that science is capable of anything, that a new magic emerges from the laboratory. It is just as important to be aware of the limitations imposed on us by the nature of the world as to have a quick understanding of the tremendous possibilities available for control of phenomena. No really scientific explanation of events is possible without both of these sides. It is necessary to see why the atomic bomb itself was a natural and somewhat predictable outcome of physics, and at the same time why a ray to detonate the bomb is an unlikely and unforeseeable outcome of any present scientific knowledge.

The impact of nuclear energy, especially of its destructive military uses, has been great. It is the purpose of this paper to urge that science teachers in all fields attempt to understand and to explain the issues which the bomb raises, both in their narrow sphere of technical and scientific education, and in the wider and still more pressing one of the social implications they contain. If we are to live in our cities for another few decades, it will be because we have understood the change the bomb has brought. If we are not to see negated the promise of nuclear energy for the world's work but rather its threat to the very life of nations, it will be because we have told what we know. The scientific people who helped develop this new form of energy have decided almost unanimously to urge on the nation the necessity of its international control; we are confident that understanding the facts will lead any person to share our conviction of the changes that lie ahead. There is not much time.

"LIFE" AND "FORTUNE" MAGAZINES AS SOURCES OF SCIENCE PICTURES

WILLIAM F. GOINS, JR.
Hampton Institute, Hampton, Virginia

FOR several years now I have been scanning back copies of *Life* and *Fortune* magazines whenever they could be secured for pictures suitable for use in science classes. I have used these pictures in both high school and college classes in general science, biology, and chemistry quite effectively. They are suitable for mounting on the bulletin board, for binding into folders to be passed around, and some are excellent for opaque projection.

Quite recently I took time to tabulate some representative pictures from my files as to their subject, source, whether they were colored, and their suitability for various science courses. A total of ninety pictures was analyzed. Fifty-four of these were taken from *Life* over a period of several years, forty-three were from *Fortune*, and the other three were from other sources. Forty-two pictures were in color. Many which I listed as one picture were in reality a series of several pictures on the same subject, some of which in the series were generally in color.

A tabulation of these pictures for suitability in various science areas showed nine particularly useful in chemistry, four particularly adapted to physics, ten peculiarly biological in subject, and fifteen especially suitable for use with general science classes. The others studied were adaptable for use in two or more science areas.

The range of subjects was quite interesting and very broad. For example, some titles are: *Blood; Solar System; Reproduction in Opossum; Volcano; Military Planes; Demonstration of Light and Lenses; Turbines; Jet Propulsion; Ballistics; Movie Making; Electric Motor; Lithium; Magnesium; Plastics; Penicillin; Steel Mill; Tropical Diseases; Crude Oil; Color; Glass; Seeds;* and *Household Pests.*

In size, these pictures range from full-page down to about 3 x 5 inches. Nine of the ninety studied were in full color and suitable for opaque projection as they were 5 x 8 inches, or smaller.

In using these pictures, since so many are a series of panels continuing through several pages of the magazines, I usually bind them in folders for distribution in class. Others which have nothing of importance on the reverse side, are mounted with paper cement on construction paper of proper size and color for display on the bulletin board. Black and white pictures for display are mounted on black construction paper, and colored ones are mounted on some harmonizing colored paper for a mat effect.

Because of the different sizes of these pictures (some are as large as 14 x 10½ inches) I do not file them vertically in the usual filing case. For my purposes, a discarded map case comes in handily. Some time ago I acquired a case having twenty large, flat drawers, about 28 x 20 x 1½ inches, with maps of various states in the bottom of each. These drawers are used for filing the pictures, by laying the pictures flat in the drawers. This system necessitates a bit of handling to find the desired one, but prevents bending of large pictures to fit into the vertical file.

I have used pictures from this file over a period of five years with high school classes in biology and general science, and for the past three years with college classes in chemistry and physical science. In all instances, they have proved interesting and

stimulating to students, and inexpensive to secure. Frequently back copies of the magazines may be secured from friends, or can be purchased at modest cost from used-book dealers. In any case, all you require are scissors, paste, mounting paper, old magazines, and a little time. These will pay dividends in awakened interest, more attractive classrooms, and quicker learning on the part of your students.

AN INVESTIGATION OF THE DIRECTOR OR SUPERVISOR OF SCIENCE IN THE PUBLIC SCHOOLS

ROBERT H. CARLETON

Chairman, Science Department, Public Schools, Summit, New Jersey

I. BASIS OF THE STUDY

THIS study was undertaken as an effort to find the answers to certain questions relating to the supervisory aspects of the programs of science education as found in the public school systems of the larger cities of the United States. In view of recommendations and implications of three significant reports on science education published during the past dozen years [1, 2, 3] and also the writings and teachings of frontier thinkers in the field, one would expect to find today considerable evidence of educational planning and guidance for instruction in science. At least, that was the hypothesis underlying this study.

The investigator was particularly concerned with finding out about the status of supervisory practices in secondary school science, and in school systems having several relatively large schools with many science teachers, rather than in small systems having, say, one high school with perhaps only two or three science teachers at most. Also, the study was concerned with centralized supervision provided for all the schools within the system, rather than the supervision provided within any given school.

As stated in the letter of transmittal that accompanied the questionnaire by means of which the study was conducted, the investigator hoped "to find out something about (a) who guides, directs, or supervises the program of science education in our schools; (b) what the science supervisor actually does to improve instruction in science; (c) what supervisory practices and techniques are employed; (d) what the chief obstacles are that have to be overcome by the supervisor; (e) what training is considered necessary or desirable for the science supervisor; and (f) certain miscellaneous items." The questionnaire is reproduced herewith.

The questionnaire was submitted to the science supervisor or the superintendent of schools in 48 cities of not less than about 150,000 population. Replies which were usable in whole or in part were received from 31 of these, or 64.6%. The distribution of the questionnaires submitted and replies received is shown in Table 1.

TABLE I

Geographic area	No. of questionnaires sent	No. of replies received
Eastern states	13	10
Southern states	12	8
North Central and Mid-western states	18	11
Mountain and far Western states	5	2
	48	31

II. THE FINDING

(a) Who guides, or directs, or supervises science education? Of the 31 sys-

tems replying, only 22 or 71% assigned any responsibility for this supervisory function to any person at all who served the entire school system. These 22 supervisory agents were distributed as shown in Table II.

THE QUESTIONNAIRE

A QUESTIONNAIRE STUDY OF THE DIRECTOR OR SUPERVISOR OF SCIENCE EDUCATION IN THE PUBLIC SCHOOLS

I. Duties and Responsibilities.—Mark with plus signs in column I those duties and responsibilities which you consider to be normally an important and/or frequent phase or aspect of your work. Mark with minus signs those which are minor or infrequent aspects. Mark with zeros those which are not an aspect of your work. In column II indicate the five or six, or so, duties or responsibilities which you consider most important; number them in the order of decreasing importance. Extend the list of items by writing in others if you wish.

II. Training and Preparation.—Indicate in column I the types of training or preparation which you consider important factors leading to success in science supervision; number these items from 1 on in the order of decreasing importance. Extend the list by writing in others if you wish.

Item	Duty or responsibility	I	II	Remarks
1	Contact industry in community and determine types of openings, science training, etc., needed			
2	Conduct publicity or public relations program			
3	Guide, direct, or conduct research or experimentation in various phases of science education			
4	Organize special courses in science to meet changing needs of students			
5	Conduct a science fair for your system			
6	Review techniques and devices for evaluating the outcomes of instruction			
7	Prepare lists of demonstrations, references, visual aids, etc., for use by teachers			
8	Prepare digests of educational research, articles, etc., in science education			
9	Arrange for speakers, panels, demonstrations, etc., for meetings of your teachers			
10	Guide or assist in the selection of textbooks, workbooks, lab manuals, etc.			
11	Provide visual aids for science instruction, perhaps in cooperation with visual aid dept.			
12	Check or supervise inventories of equipment and supplies			
13	Take care of or supervise the repair and maintenance of equipment			
14	Supervise preparation of requisitions and awarding of orders for supplies and equipment			
15	Conduct or arrange for in-service training courses, such as radio, aeronautics, etc.			
16	Assist in the selection of new teachers			
17	Visit, observe, and confer with individual teachers and prepare ratings			
18	Review or develop a philosophy of science education			
19	Encourage research attitude, research projects, and writing by teachers			
20	Encourage and aid in organizing student science clubs			

Item	Type of training or preparation	I	Remarks
31	Undergraduate courses leading to BA or BS degree		
32	Undergraduate courses leading to BS in Ed. degree		
33	Graduate courses in science subject fields		
34	Graduate courses in the field of education		
35	Successful teaching experience		
36	Industrial or other practical experience		
37	Personal reading, cogitation, planning, etc.		
38	Professional literature, conventions, etc.		
39	Meeting and talking with others in like work		

III. General Items.—Mark the following items in column I as indicated for each item.

Item	Query	I	Remarks
50	What fraction of the possible teaching periods per week in your system do you teach? Answer as 14/40, 15/28, 0/35, etc.		
51	How many years continuously including the current year has such a supervisory position been in existence in your system? (1) less than 5; (2) 5 to 9; (3) 10 to 14; (4) 15 years or more.		
52	Do your supervisory duties cover science education in grades (1) 1 to 12 or more; (2) 7 to 12 or more; (3) 9 to 12 or more; (4) 10 to 12 or more?		
53	Is the probable top salary for this position in your system (1) not more than $3,000; (2) $3,000 to $3,500; (3) $3,500 to $4,000; (4) $4,000 to $5,000; (5) more than $5,000; (6) do not care to answer.		

IV. Questions.—Answer as fully or briefly as you care to or have time to.

60. How would you describe the broad objectives or goals of your program of science education?
61. What are the chief supervisory techniques by which you attempt to assure success of your planned program as regards (a) principals of the schools; (b) individual teachers?
62. What are the chief obstacles or difficulties you have to overcome in trying to carry on successfully your planned program?
63. What organizational set-up do you have among your science teachers, such as committees for biology, chemistry, etc., committee of building chairmen, science teachers clubs, etc.?

Your name ..... *Title* .....
Do you wish to receive a copy of the summary of this study? .....
What is the round-number population of your community? .....
How many schools in your supervisory set-up of the following types?
Grades 1 to 6 .....; *1 to 8* .....; *7 to 9* .....; *9 to 12* .....; *10 to 12* .....; *vocational or special* .....; *other types* .....

TABLE II

Science supervisor	5
Assistant superintendent	4
Assistant superintendent in charge of curriculum	2
Assistant superintendent and/or research director	2
Assistant superintendent and science supervisor	2
Director or supervisor of science and visual aids	3
Chairman of science committee or council	2
Director of elementary education	1
Special teacher of science	1

(b) What does the science supervisor actually do to improve instruction in science? This query is answered by the replies to section I of the questionnaire, the tabulation of which is given in Table III. Not one additional "duty or responsibility" was added to the original list by any of the replicants. Twenty-six marked the items plus, minus, and zero as directed, but relatively few replicants marked them in the order of decreasing importance. No reasons were given for not marking them.

TABLE III

Item No.	No. marking item: plus	minus	zero	No. rating item: 1st	2nd	3rd	4th	5th	6th
1	8	11	7		1			1	
2	2	17	7	3					
3	14	10	2			1	1	1	
4	22	3	1	2	3	2	3	3	2
5	2	10	14						
6	18	8	0		5	3	3	1	1
7	22	3	1	2	2	1	1	2	1
8	6	17	3						
9	18	8	0	1	2		2		1
10	22	3	1		2	1	2	3	3
11	23	3	0	2	1	2	2	3	1
12	19	5	2		1	1	2		1
13	13	6	7			1			
14	16	5	5	1	1	3		3	1
15	13	11	2		1		4	1	
16	12	8	6	1				1	2
17	21	2	3	9	5	2		1	2
18	17	6	3	5	1	5	2		
19	13	11	2			1			1
20	10	14	2					1	

(c) What supervisory practices or techniques are employed? Item 61 on the questionnaire related to this query; only 17 replies carried an answer to it. Typical of these answers are the following:

"Attempt their sympathetic understanding;" "conferences, group discussions, and visitations;" "demonstration lessons;" "visit and confer with individual teachers;" "by means of workshops;" "working out courses cooperatively."

The following reply from a mid-west science supervisor seems specially noteworthy and is quoted in full: "All plans for policies in science in the high schools are handled through a Principals' Science Committee of which I am secretary. These policies are then put into practice through the department heads. Suggestions for these policies come originally from teachers through committees working on various problems. I try to make the teachers feel that this is their program."

An analysis of the committee set-ups and procedures reported for working out curricular materials reveals the types of committees tabulated in Table IV.

TABLE IV

Special subject committees	7
Occasional committees appointed as needs arise	5
Curriculum committee; teachers from all schools	3
Science council of building department heads	2
Curriculum committee with rotating membership	1
Skeleton committees on recurrent problems; members added when there is work to be done	1
Committees in individual schools	1

(d) What are the chief obstacles that have to be overcome by the science supervisor?

The replies to item 62 on the questionnaire are summarized in Table V. They provide an answer to the query above.

TABLE V

Untrained teachers	7
Conservative or apathetic attitude of "traditional" teachers	5
Scarcity of qualified teachers in war time	3
Lack of provision for staff supervision	2
Mental inertia of administrators	1
Failure of administrators to appreciate values of science	1
Encroachment of social and commercial studies	1
Lack of sufficient time for science (elementary)	1
Lack of materials and equipment (elementary)	1

(e) What training is considered necessary or desirable for the science supervisor? The tabulation of the replies to section II of the questionnaire gives the answer to this query (see Table VI). Again, no additional items were written in on any of the replies.

TABLE VI

Item No.	No. rating item: 1st	2nd	3rd	4th	5th	6th	7th	8th	9th	No. omitting
31	10	3	2	2				3		5
32	3	3	2	2	2	1	1	1	2	8
33	3	7	6	3	1	3	1			2
34	1	4	9	3	3	2	1	1	1	
35	12	5	7		1					
36		1		5	3	2	2	4	2	5
37	2		1	5	4	1	7	2		4
38	1	1		1	6	6	3	4	1	2
39		1	2	2	6	5	4		2	2

(f) Miscellaneous items. An examination of the replies to items 50, 51, 52, and 53 of the questionnaire reveals the following. Fifteen supervisory agents reported they do no teaching at all. This group includes all the assistant superintendents and curriculum and research directors who replied, and four of the five science supervisors. The fifth supervisor reported teaching "10 periods out of 35 at my own request." Other replicants indicated that two teach half-time, one teaches 8 out of 35 periods per week, one 10 periods out of 35, one 10 out of 30, one 20 out of 35, and one 30 out of 50.

The supervisory position has been in existence less than five years in only one school system; 5 to 9 years in four; 10 to 14 years in five; and 15 years or more in nine. In the five systems having a definite science supervisor as such, the position has existed less than 5 years in one, 5 to 9 years in two, and 10 to 14 years in two.

Indicative of the extent to which 15 school systems are operating a planned "program" of science education is the report that supervisory duties in science range through grades 1 to 12 in seven systems, 7 to 12 in five systems, 9 to 12 two, and 10 to 12 in one. Of the science supervisors, one works through grades 1 to 12, three through grades 7 to 12, and one through grades 9 to 12. In two of the 7–12 systems, there is also a separate science supervisor for the elementary schools. In the third 7–12 system, the supervisor reported that he has responsibility for grades 7 and 8 in five junior high schools but no jurisdiction at all for the same grades in about fifty elementary schools of the city which also include grades 7 and 8; there is no elementary-science supervisor in this system. Five systems reported having some supervisory agent, such as a "special teacher of science," for science at the junior high school level, but nothing of the sort for the senior high school level.

(g) What are the top salaries for these supervisory positions? The replies to this query are tabulated in Table VII. In reading this table, it should be remembered that all cases except five represent central administrative officers. Among the five science supervisors, one reported a top salary of $3500 to $4000, one of $4000 to $5000, and three of "tops" of more than $5000; one of the latter group reported specifically that the salary maximum for his position is $7,050.

TABLE VII

Not more than $3000	3
$3000 to $3500	3
$3500 to $4000	3
$4000 to $5000	6
More than $5000	5

Two other queries asked in the questionnaire (items 60 and 61) brought forth such a variety of responses and comment that no significant summary could be made of them. The broad objectives or goals of the science program were described by phrases ranging from "a general knowledge of the sciences" and "to lead students to know and understand the great world of science," through "an increased understanding of the environment," to the succinct and significant statement of "science for better living at all grade levels and for all ability groups." Only five replies made any mention of scientific methods and scientific methods of problem solving.

(h) What trends in the supervision of science education are indicated? While the foregoing tabulations of replies to the various items in the questionnaire indicate the present status of certain aspects of supervision in science education, the letters and explanatory remarks returned by the replicants provided some most interesting sidelights on the attitudes toward, and the functions of, such supervision. Excerpts from a number of these comments are quoted in the following paragraphs; in every case, any italics or parenthetical expressions are the investigator's.

The superintendent of schools in a large southern city wrote, "We do not have a supervisor or director of science for the high schools of *X*. In *most* of our schools, we have a head of department and this individual serves *somewhat* as a chairman for the science group."

From another southern city comes this: "*What direction this subject receives* it gets through the assistant superintendent in charge of high schools and through the principal of the high school." One might infer that in this city, this subject does not get very much supervision or *direction*.

The following comment was received from a highly industrialized, midwestern city: "In the *X* school system we have no supervisors for special subjects nor are there department heads. High-school principals have the responsibility for the supervision of instruction."

The Research and Curriculum Director in another mid-western city reported: "A committee of teachers and principals is at work now taking the preliminary steps to a complete revision of our science curriculum in the elementary schools . . . . We are not convinced of the desirability of special subject supervisors and do not at present contemplate one in this field."

And a science supervisor who did not reply to the questionnaire wrote as follows by way of explanation: "It is very difficult for me to fill out since *the questions you ask are of an educational nature and the supervisorship of science in X is largely of a business nature.*" Believe it or not!

Following receipt of a filled-out questionnaire from a Chairman of Secondary School Science in an eastern school system (which indicated at least a moderately progressive supervisory program for science), the investigator had an opportunity to discuss this program with another teacher of chemistry of perhaps 20 years experience in that system. The theme of this teacher's comments was stated in his first sentence: "As a supervisor, she lets us beautifully alone."

The Director of the Bureau of Research in a southern city reported, "The science program in the *X* schools is carried on without benefit of *centralized* supervision. The curriculum materials now in use were developed by a committee of teachers from 1935 to 1937. Responsibility for this phase of the educational program rests *largely* with the individual principals. The information (on the returned questionnaire) is an expression of what *would be*, or *might be*, considered desirable, rather than being a description of what *is* being done."

From a supervisor in an eastern system: "Sorry; I don't believe there is any well-planned (supervisory) objective for the school system as a whole. What has been done *on paper* would pass *X* University's Curriculum Department, however. Supervisory obstacles are that *department chairman have no authority*, and the little tin god, 'We're doin' OK; why change?'"

Finally, the following appraisal of the supervisory program in a large eastern city was contributed by the chairman of a system-wide Science Council: "At present *there are no apparent goals, nor is there a definite* (science) *program.* Each school attempts to do what it can to maintain a 'status quo.' Techniques (of supervision) are entirely up to the principals of the various schools, none of whom is trained in the field of science. The Science Council is a democratic body without authority to act. *Chief obstacle is the lack of a supervisor with status.*"

Helpful in formulating a concept of what the trends are in the supervision of science instruction is to compare the findings of this study with the supervisory situation of a dozen years ago as reported by Beauchamp in the National Survey of Secondary Education. [4] A number of pertinent excerpts from Beauchamp's report are quoted in the next few paragraphs; again,

italics and parenthetical expressions are the present writer's.

Investigating the manner in which some 160 courses of study were prepared, Beauchamp found that "the majority of courses were formulated by committees representing each of the different fields of science . . . . No reference was found which might indicate that the course was formulated by a single committee representing the *whole* field of science. Administrators apparently regard each of these subjects as a special field, rather than a *sequence* of subjects having a common core, with overlapping aims, methods, and psychology of learning. Conversation with teachers of science leaves a like impression." (p. 3)

These committees, for the most part, operated under 1. a director of curriculum; 2. a supervisor of science; 3. the direction of outside talent; or 4. no supervision at all. Beauchamp reported that "a comparison of the courses of study prepared by committees under the direct active control of the supervisor with those courses in which the control of the supervisor was limited, indicates the superiority of those courses over which the supervisor had the greatest amount of control. This superiority is evidenced most clearly by a comparison of the junior high school courses with the senior high school courses. In the junior high school, teachers as a rule are accustomed to supervision . . . they are eager for suggestions; they regard the supervisor as an expert in the field. *Senior high school teachers have no such regard for the supervisor; in fact, their attitude is often antagonistic* . . . the majority of senior high school teachers are not prone to recognize expertness in the field of science *teaching;* they recognize only expertness in the subject matter of a certain division of the field of *science. Examination of courses of study and observation of classroom teaching leads the investigator to believe that the majority of senior high school teachers would profit by more contact with the science supervisor.*" (pp. 5–6)

Following a somewhat detailed analysis of several typical courses of study, Beauchamp concluded: "It is significant to note that the more innovating courses have been organized in school systems which have a director of curriculum or a science supervisor, or who called in an outside expert." (p. 26)

Discussing his findings on instructional techniques, Beauchamp concluded that "curriculum makers have assumed that teachers can and do employ those methods which will attain (all) the objectives of science teaching. Observation of several hundred teachers during the past five years supplemented by conversations with principals, superintendents, and others has led the writer to doubt the validity of this assumption." (p. 43) The present writer would ask, Whose responsibility is it to guide, direct, and supervise science instruction in the classroom to the end that these objectives will be attained, and how can it best be done? Or, is this matter important enough to worry about?

III. CONCLUSIONS

1. The findings of this study seem to indicate that some progress is being made in efforts to improve the effectiveness of science instruction at the secondary level in the larger school systems by providing some kind of system-wide guidance, direction, or supervision. However, the trend is not very widespread (22 out of 31 systems), and it does not seem to be accelerating (such supervision being less than 5 years old in only one system and more than 15 years old in nine systems).

2. The direction and guidance accorded science education is more likely to come from an assistant superintendent or curriculum or research director (10 cases out of 22) than from a special subject supervisor (5 cases out of 22). This might be interpreted to imply that school officials

frown on compartmentalizing by special subject fields, and prefer to build all curricular materials and practices on one system-wide philosophy of education.

3. Apparently, the feelings of senior high school teachers toward supervision have not changed materially since 1932, when such feelings were described by Beauchamp as "often antagonistic," inasmuch as 15 out of 25 "supervisory obstacles to be overcome" related directly to the classroom teacher. One cannot avoid gaining the impression that in general, senior high school teachers feel that they know their subject and how to teach it, that they need no supervision, and that they need not be very much concerned with a *science education program*. In this situation, probably, is to be found the reason for a number of supervisory officers stating that they lacked authority "to act" in attaining their supervisory goals.

4. Supervisory agents concerned with science education evaluated their duties and responsibilities as follows: 9 considered "visitation and observation" to rank first in importance, while 5 rated it second; 5 considered "reviewing or developing a philosophy of science education" to rank first and 1 ranked it second.

Duties and responsibilities evaluated as "important and/or frequent in occurrence" by 80% or more of the replicants include: organizing courses in science; preparing lists of demonstrations, visual aids, etc.; providing visual aids; and visitation and observation. It is interesting to note that "contacting industry in the community," "conducting publicity," and "conducting a science fair," all of which could contribute to good public relations, were rated as important and/or frequent duties by only 8, 2, and 2 replicants, respectively.

Items relating to the professional aspects of science *teaching* were rated important and/or frequent as follows: "guide, direct, or conduct research in science education," 14 cases; "review techniques for evaluating outcomes," 18 cases; "prepare digests of science-education articles and research," 6 cases; review or develop a philosophy of science education," 17 cases; "encourage research attitude and writing by teachers," 13 cases.

One more striking practice may be noted; namely, that although the supervisory agents would be expected to have some responsibility for the *quality* of instruction, only 12 out of 26 reported "assisting in the selection of new teachers" as an important and/or frequent duty; 8 listed this as a minor duty, while 6 reported that it is not an aspect of their work at all.

5. Committees working under the guidance or direction of the supervisory agent are the chief method by which courses of study and other curricular materials are prepared. Specialized subject matter committees predominate (7 cases out of 21), although an equal number of committees of other types were reported, all of them concerned in one way or another with the total science program of the school system. Two systems reported a committee organization including both a main *science education* committee and subordinate committees for the specialized subject areas working in harmony with the main committee. These findings indicate some gain over the practices reported by Beauchamp, although the evidence is not conclusive.

6. Successful teaching experience is rated the most important item in the training and preparation for supervision, 12 replicants rating it first, 3 second, and 7 third. Undergraduate courses leading to the BA or BS are rated as more important than courses leading to the BS in Ed. degree. Graduate courses in the specialized subject matter areas are rated higher in importance for supervisors than graduate courses in the field of education. The implied small regard for training in *science education* and the higher regard for training in science subject matter, even by the supervisory

officers themselves, conforms to the attitude reported by Beauchamp twelve years ago.

7. Responsibility for the direct or intimate supervision of instructional practices, and for carrying out the science program in actual classroom conditions, is by no means assigned solely, or even chiefly, to the central supervisory agent. Building principals and department heads carry much of this responsibility, although there is considerable feeling among the latter that they lack authority "to act."

8. This study was concerned only with certain aspects of the system-wide program of supervision for science education in the larger systems. Therefore, it does not reveal a complete picture of the total supervisory practices in these school systems. Additional studies might be made of the supervisory philosophy and practices of principals and department heads in these systems; also, of the supervisory situation in small schools and small school systems as well as in the larger ones. A study of the educational outcomes and values of supervisory programs of various types would likewise be of value to school authorities in planning a program of science education for their systems.

BIBLIOGRAPHY

1. National Society for the Study of Education. *Thirty-First Yearbook*, A Program for Teaching Science. Public School Publishing Co., Bloomington, Ill., 1932.
2. Progressive Education Association. *Science in General Education*. D. Appleton-Century Co., New York, 1938.
3. National Committee on Science Teaching. *Science Teaching for Better Living*. National Education Association of the U. S. A., Washington, D. C., 1942.
4. Beauchamp, Wilbur L. *Instruction in Science*. Bulletin, 1932, No. 17, Monograph No. 22, U. S. Office of Education.

HOW IS DIFFICULTY OF SUBJECT MATTER A FACTOR AFFECTING LEARNING GENERAL SCIENCE? *

VICTOR C. SMITH

Ramsey Junior High School, Minneapolis, Minnesota

IN consideration of the relation of subject matter to the ability of the pupil to learn that subject matter successfully, there are two definite and opposed schools of thought.

According to one view, which is represented in its most extreme position by certain objective test makers, a given item of subject matter taught to a given school population has a definite difficulty which can be determined by converting it into an objective test item; that is, for a certain school population a given item will be answered correctly by a certain per cent of pupils, and that thereafter the difficulty of this item for all similar populations is known almost as definitely as is a unit of measurement in the physical world.

According to the other view, learning of subject matter is affected by many factors which change its difficulty from group to group, individual to individual, and time to time. Variations in such factors as motivation, interest, and amount and method of exposure are assumed to make the learning of given subject matter more or less difficult. Thus according to this second school of thought, the relative difficulty of subject matter is highly variable.

More exact knowledge than exists at present is required to resolve these contradictions, not only for making of tests, but for planning courses of study and grade placement of topics and problems.

* This is an abstract of a portion of the PH.D. thesis, Factors Affecting Learning of General Science, which is on file at the Library of the University of Minnesota. In this abstract bibliography and tests of significance have been omitted for brevity.

It is apparent that a subject matter item cannot be both fixed and variable in difficulty when presented to a given school population in a course of study or in a test.

To test the hypothesis that specific items of science information have a fixed difficulty for various populations, the following experiment was set up:

1. A general science test of 750 items was "standardized" by the usual process of administering it to a selected school population.

2. Items of this test were added to an equal number of related items, and specifically taught to an experimental group.

3. An item-by-item comparison was made of the per cent of pupils who succeeded in learning each item, in the standardizing and experimental groups.

Because studies of construction and standardization of test items indicate that the reliability of individual test items is somewhat higher in the completion form than in other objective test forms, all items were converted into completion form. In order to select items, ten textbooks of general science were surveyed. One hundred twenty-one items were selected which were found in four or fewer textbooks, all the remaining items being represented in five or more books.

The subject matter of the test included approximately the same proportion of material that was common to the ten textbooks from which the items were selected. That is, 376 items were selected from material related to physics, 81 items from chemical material, 106 from information related to human biology, 76 items from general biology, 103 from the earth sciences, and 8 from information concerning the scientific method.

This test was broken into sections of 50 items each, and given to 300 boys and 300 girls in fourteen selected schools. All pupils had studied ninth grade general science for one year at the time at which the test was given.

The difficulty of each item was then determined by calculating the per cent of correct responses of boys and girls separately, and these scores were averaged. In this way each item was "standardized" according to accepted test-making practice.

THE EXPERIMENT

An experimental group of ninth grade pupils was taught by the experimenter. The object of the experiment was to attempt to increase, by intensive teaching, the per cent of success of the experimental group as compared with the standardization group.

The items were grouped according to their proper place in the course of study, then sorted into smaller groups to fit into daily assignments. Additional items were included to make a lesson summary, somewhat according to the plan followed in the textbook, *Science in Daily Life* (J. B. Lippincott Co., 1936).

Many teaching techniques were employed. A number of textbooks was available, and each pupil in the experimental group used more than one standard general science text for reference and study. Demonstrations, film strip slides, blackboard diagrams, collections, microscope work, wall charts, outside reading of current science publications, pupil projects, recitation, lectures, and frequent short tests were used to assure adequate understanding and presentation of the items.

In addition to the usual teaching techniques, the item summary of five to ten items daily was dictated orally to the pupils, who wrote the items into a special notebook. To insure maximum effort on their mastery pupils were informed that the majority of test items would come from these notebooks. Pupils were encouraged to review these summaries frequently, and were informed that they would have a final semester examination over the material.

It may be considered that each of the approximately 1500 items so presented

was actually studied intensively by every pupil in the experimental group.

The numbers of pupils tested in the experimental group varied because of administrative changes in class assignment. One group of 120 pupils was given the entire list of 750 items as a pre-test. On 450 of the items a group of 360 pupils was tested at the end of the semester in which materials were taught. On the remaining 300 items it was possible to test a total of 635 pupils in the experimental group. The pretest group had not studied general science.

Comparison of intelligence test scores and other data available in the school office showed that classes composing the experimental group were homogeneous, and that no variation in ability greater than might be caused by chance errors of measurement existed from group to group.

Per cent of pupils answering each item correctly was calculated for the experimental group according to mental age. The results of this calculation is summarized in the table. (Table 1.)

It will be noted that the average of the standardizing group was 38.67 per cent correct responses, while in the experimental groups all but the mental age 14.5 group exceeded this average to a statistically significant degree. No exact interpretation of the comparison is possible, because the mental age of the standardizing group is not known. It is highly unlikely, however, that the standardizing group had an average mental age of less than 15.5 years.

The differences according to mental age groups are statistically significant, indicating that mental age is a factor in success in learning general science information. A

TABLE 1

THE DISTRIBUTION OF THE 750 ITEMS ACCORDING TO PER CENT OF SUCCESS FOR STANDARDIZATION, PRETEST, AND EXPERIMENTAL GROUPS

Per Cent right	Standardization	Pretest	Experimental Groups			
			MA 14.5	MA 15.5	MA 16.5	MA 17.5
95–100	2	0	4	5	11	25
90–94.9	11	0	5	12	29	41
85–89.9	16	0	8	17	27	61
80–84.9	12	2	16	26	31	55
75–79.9	20	0	16	26	49	70
70–74.9	23	3	14	41	37	63
65–69.9	29	6	21	37	54	44
60–64.9	33	4	35	42	56	67
55–59.9	50	5	26	48	64	57
50–54.9	49	10	43	43	46	62
45–49.9	33	11	45	49	53	45
40–44.9	56	12	61	56	43	40
35–39.9	53	16	56	62	57	35
30–34.9	55	17	60	58	54	36
25–29.9	56	22	56	54	48	18
20–24.9	68	25	53	59	39	10
15–19.9	51	45	69	51	22	13
10–14.9	50	51	64	30	20	4
05–09.9	39	93	18	11	2	3
01–04.9	44	273	80	23	8	1
00–00		155				
Mean	38.67	10.79	35.05	43.43	52.73	62.84
S.D.	23.15	15.81	20.10	22.90	22.95	22.85
σM	0.845	0.566	0.730	0.832	0.832	0.831

Read the table thus: On two items 95 to 100 per cent of the pupils in the standardization group answered correctly, 90 to 94.9 per cent answered 11 items correctly, etc.

gain of one year of mental age produces a gain of about 9 per cent in ability to learn these items.

It is worth noting that the pretest group encountered 155 items in the test which no pupil was able to answer correctly, and that altogether 428 items were answered correctly by less than 5 per cent of the pretest group. It is apparent that the completion test form requires considerable knowledge for successful responses.

While Table 1 shows how difficult the items are for the various groups in the experiment, it still does not answer the question as to whether or not the relative difficulty of the items varies from group to group.

Accordingly for the 750 items, per cent of success of various groups in answering the test was correlated. The results of this correlation follow in Table 2.

TABLE 2

CORRELATIONS OF PER CENT OF SUCCESS OF CERTAIN SELECTED GROUPS WITH THAT OF OTHER GROUPS

Group Correlated	Correlation
Experimental groups MA 15.5, MA 16.5	.916
Experimental groups MA 14.5, MA 17.5	.836
Standardization group, Mean of MA 15.5 and 16.5	.741

All correlations were calculated by the Pearson Product-Moments method.

The correlation of .916 indicates that the items have about the same relative difficulty for groups MA 15.5 and MA 16.5 even though the MA 16.5 group exceeds the MA 15.5 group in average success on the items.

The correlation of .836 for groups MA 14.5 and MA 17.5 indicates that as groups become more unlike in mental ability, the relative difficulty of items tends to change, although the items that are difficult for one group are still difficult for the other.

The most significant correlation is that between relative difficulty of items for the Standardizing group and the combined MA 15.5 and 16.5 groups from the experiment. A correlation of .741 is fairly high, indicating that items of a given difficulty for the standardizing group were relatively of a similar difficulty for the experimental groups. But it also is low enough to indicate that there is considerable shifting of relative difficulty of items, in addition to the absolute change in the per cent of success as indicated in Table 1.

Further correlations were calculated between the individual pupils' total scores on items and Mental Age and I.Q. These are:

$$r\text{MA, Item score} = .528$$
$$r\text{IQ, Item score} = .556$$

These are about the usual relationships between scores of scholastic success and measured mental ability. They indicate that factors other than so-called intelligence play an important part in learning general science. They also indicate that rote memory did not affect the test scores more than is common in similar correlations in other studies.

Actual analysis of the changes in difficulty of 725 of the items was made by comparing the per cent of right answers of the standardizing and the combined MA 15.5–6.5 experimental groups. The greatest difference in per cent of success on any item was 63.5 per cent, which was an item which many pupils of the standardization group apparently had not studied. On seven items the scores of the MA 15.5–16.5 groups exceeded those of the standardizing group from 50 to 59.9 per cent; on 16 items from 40 to 49.9 per cent, on 44 items from 30 to 39.9 per cent, on 104 items from 20 to 29.9 per cent, and on 180 items from 10 to 19.9 per cent. On 348 items the scores of the two groups deviated less than 10 per cent.

On the remaining 45 items the scores of standardizing group exceeded those of the experimental MA 15.5–16.5 group by 10 or more per cent.

A SECOND EXPERIMENT

A second, somewhat similar experiment was performed, except that instead of using 1500 items, a new experimental group was given only a small group of approximately 150 items to learn. This material consisted only of principles of science. The experimental group for the second experiment was identical in ability to the first.

Comparison was made between the scores of the two groups on 40 items which were common to both lists of items. On the 40 items the first experimental group made an average score of 47.5 per cent answering each test item correctly, while the second group made an average score of 73 per cent answering each item correctly.

CONCLUSION

1. The difficulty of tested items of information may vary as much as 50 percentage points when conditions and amount of exposure vary greatly.

2. Under conditions of fairly uniform exposure and learning effort, the range of difficulty of items is almost 100 per cent.

3. Although increasing exposure and learning effort decreases the tested difficulty of items, still no reasonable additional learning effort and exposure will make any large change in the per cent of pupils learning specific items of information covered in a year of study of general science.

4. The mean difference in success on tested items due to one year of difference in mental age is somewhat more than 9 per cent.

5. When conditions of learning, effort, and exposure remain relatively constant, the difficulty of a given item of science information remains highly constant.

6. The difficulty of the sampled items was too great for the average ninth general science pupil to master with 50 per cent success under the conditions of the experiment.

7. The more nearly alike are tested groups in mental abihty and methods and amount of exposure to material, the greater is the stability of the difficulty of individual test items.

8. A pupil by studying science one year, on the material tested, learned about 3½ times as much as he knew at the beginning of the year of this tested material.

9. By concentrating on relative few items, perhaps 100 or 150, and by employing methods of overlearning, the average success of pupils in recalling completion items can be increased perhaps 25 per cent on this overlearned material.

10. The most important factor in success in learning general science information is the selection of items of content to be learned.

11. Within the range encountered in a normal general science class, variations in mental ability are secondary in importance in determining success in learning general science information.

12. Variations in method and amount of exposure, provided that material is actually taught, and over a year's work in general science, rank third to type of material and differences in ability, of the three factors measured in this experiment in determining success in learning general science information.

POSSIBLE HEALTH TEACHING OBJECTIVES AND EVALUATION OF THEIR ATTAINMENT

BERNHARD J. STERN
Columbia University

IN order to be able to evaluate his teaching in the field of health a teacher must have his objectives fairly well defined. A formulation of objectives serves to bring teaching into clearer focus and guides selection of subject matter in a functional and integrated manner. It helps to fit specific activities into a total picture and to give dynamic continuity to what would otherwise tend to be isolated, unrelated phenomena.

The objectives suggested in the following pages are given as illustrative proposals from which each teacher will select those that have most immediate relevance to the interests and emotional maturity of his classes and to the needs of his community. They may, in fact, merely serve as a point of departure for an alternate set of proposals conceived by the teacher to be more appropriate in his situation. These objectives are framed in the setting of an approach to science teaching in health the primary goal of which is to enable a larger number of people to grapple rationally and creatively with the problems they face and in this way to promote the welfare of individuals and of the society of which they are a part.

TABLE OF TEACHING OBJECTIVES

Desirable goals which are thought helpful in directing the focus of science teaching in this area may be summed up as follows:

I. Information and insights
   - A. On the functioning of the human body in health and in illness
   - B. On the choice of proper foods and the avoidance of harmful drugs
   - C. On the nature of medical care
   - D. On the causes, prevention, and treatment of communicable and other diseases
   - E. On the resources and techniques of community control of human diseases and the promotion of human health

II. Scientific methods and skill in research
   - A. In collecting information bearing on the solution of a health problem
   - B. In logical reasoning on matters of health
   - C. In the interpretation of data in medicine and public health
   - D. In recording health data by means of effective literary forms, diagrams, graphs, charts, and statistical tables

III. Attitudes and world-views
   - A. The elimination of irrational fears and aversions in matters of health
   - B. The elimination of self-consciousness arising from the health history of an individual or his family
   - C. Greater tolerance to patients
   - D. More sympathetic understanding of the problems of the medical profession and public health authorities
   - E. Perspectives in looking at the social order and the natural order and one's place in them as related to control and prevention of disease and the promotion of health
     1. As a producer affected by the conditions of health
     2. As a consumer purchasing health services
     3. As a citizen interested in local,

state, national and world health problems

IV. Overt behavior and conduct
- A. Development of personal hygienic habits
- B. The proper planning of meals
- C. Avoidance of harmful drugs and food products in spite of seductive advertising
- D. Ability to apply first aid care and to handle minor ailments in the absence of a physician
- E. The effective choice of best available medical care
- F. Coopertaion with and active support of community health agencies
- G. Cooperation with agencies promoting changes in social conditions that will affect the health situation favorably

EVALUATION OF INFORMATION AND INSIGHTS

In the understanding of the functioning of the human body in health and disease and of the role of the medical profession and of community health, an adequate vocabulary is extremely important. The study of nomenclature can, of course, become static and formal, unless every effort is made to stress processes, that is, teach definitions not by rote memorization but in the context of the function of the subject defined. The vocabulary of nutrition, for example, can easily be imparted with full appreciation on the part of the students of its relevance to their own lives. Likewise, this is true for definitions of communicable diseases and their causative germs and agents of transmission; for the names and attributes of commonly used drugs and medical instruments; and also for the nomenclature involved in study of the functioning of the human body.

There is involved in all these cases not mere names but scientific concepts, principles, generalizations, and insights in the pattern of which the names have meaning. Through the activities suggested in an earlier article[1] it will be possible for the teacher to bring out these concepts clearly and concisely in order that the mysteries commonly associated with personal and community health will be dispelled. Scientific concepts of the functioning of the human body in health and disease will show the relationship of man's health to other forms of life. They will show the social setting of health—its relation to the family, to the economic structure, and to the state. This knowledge is a means to give power—the ability to prepare the student to act wisely on the wide range of alternative forms of overt behavior that confront him in the field of health.

The acquisition of information can be tested more easily than any other result of a learning experience. Information tests may be of the written essay type, or they may be of several objective types such as true-false, multiple-choice, completion, and rearrangement tests.

Essay Tests

In giving an essay-type evaluation test the teacher should take care that the subjects selected are stated clearly and concisely, are not too broad or inclusive, are worth while for the learner, and are part of a growing body of knowledge and an enlarged understanding. They may deal with questions such as the following concerning communicable diseases:

What is meant by the "germ theory of disease"?
What are some good antiseptics and what purposes do they serve?
What precautions should a tuberculosis patient observe to avoid infection of those with whom he is in contact?
Should smallpox vaccination be voluntary or compulsory?
Why has the discovery of sulfa and penicillin compounds proved to be of such great importance?

Essay or objective tests may be given for the definition of terms and concepts,

[1] Bernhard J. Stern, "Activities Useful in the Study of the Maintenance of Health." *Science Education.* April-May, 1945, Vol. 29:124–133.

such as *vitamins, calories, malnutrition; immunity, toxoids, inoculation; phagocytosis; hemoglobin, transfusions;* to distinguish between words or phrases that are commonly and incorrectly identified.

True-False Tests

In giving objective tests, such as true-false, care should be taken that the items making up the tests are pertinent and worth knowing, represent a considerable range of difficulty, and, in the case of false answers, plausible. Negative statements should be avoided as should extreme qualifications, such as *all, none, never, always,* and ambiguous qualifications, such as *some, quite,* and *more or less.* A clear statement of the purpose of the test should precede the questions.

Example: Designed to test understanding of the way in which the human body maintains internal stability under strain, and the close functional interrelationship between circulation, digestion, respiration, and excretion.[1]

Are the statements below true or false as describing correctly the conditions in the body of an athlete who has just finished a hard, long race?

( ) 1. His blood contains an excess of glycogen.
( ) 2. The supply of lactic acid in his tissue is less than normal.
( ) 3. Oxygen is converting lactic acid to water and carbon dioxide.
( ) 4. His blood is acid.
( ) 5. The carbon dioxide content of his blood is higher than normal.
( ) 6. More red corpuscles are in his blood stream than are normally required.
( ) 7. The glycogen content of his liver is higher than normal.
( ) 8. His bodily temperature is four or five degrees higher than it was before the race.
( ) 9. The arteries and veins of his abdominal organs contain more blood than before the race.
( ) 10. His blood contains an excess of adrenalin.

[1] This and other objective tests that follow are adapted from tests originally prepared by E. A. Manwell.

Multiple-Choice Tests

1. Simple statement of fact of which only one answer is to be chosen as correct.
   Example: A dangerous drug frequently found in advertised headache remedies is: (1) acetanilide, (2) phenolphthalein, (3) caffeine, (4) aloes, (5) morphine.
2. Series of complete statements of fact from which the students must choose the best answer to a particular problem.
   Example: Rare pork may be a dangerous thing to eat because
   (1) It is difficult to digest unless it is well-done.
   (2) It may contain encysted trichina worms.
   (3) Many people have contracted tuberculosis by eating pork.
   (4) Pork muscle tissue contains a high proportion of cellulose.
   (5) All pork contains bacterial toxins which are killed by thorough cooking.
3. Students are asked to match item in one column with identifying statements in adjoining column.

   Example:

antiseptic	(*a*) substance used to prevent diphtheria
	(*b*) immune body of the human blood
	(*c*) used to destroy germs on skin surface
toxin	(*d*) poisonous product of germs
Koch	(*a*) discovered germ of tuberculosis

(*b*) discovered cure for malaria

Jenner (*c*) invented the microscope

(*d*) discovered method of smallpox vaccination

Pasteur (*e*) worked out method of inoculating against rabies

Completion Test

Example 1: On a diagram of the human body the students are asked to

(1) Label by name the organs involved in the circulation of the blood, in the digestive process, in respiration.

(2) Trace the pathway of the blood, of food in the process of digestion and absorption, and of the breathing process.

Example 2: Students are asked to complete sentences which lack one or more important words:

Most of the dangerous natural enemies of man are to be found among the (smaller) (larger) ———— organisms. When some of these get into the human body they secrete poisonous (antitoxins) (toxins) ————, which serve to (balance) (unbalance) ———— normal metabolism. Thus, diphtheria is caused by a (bacillus) (protozoan) ————, which is particularly dangerous in the case of (adults) (children) ————.

Example 3: Students are asked to insert specific information on vital statistics:

The infant mortality rate in the United States in 1945 was ———— per 100 live births.

The maternal mortality rate in the United States in 1945 was ———— per 10,000 live births.

The crude death rate for United States has dropped from ———— per 1000 in 1901–1905 to ————. per 1000 in 1945.

Rearrangement Tests

Example: Rearrange in correct order terms signifying the path of the circulation of the blood:

left ventricle, venae cavae, right auricle, left auricle, pulmonary artery, right ventricle, pulmonary veins, aorta, lung capillaries.

EVALUATION OF SCIENTIFIC METHOD AND SKILLS

An understanding of appropriate methods of work and of validating judgments in health matters requires the acquisition of many specific skills. The first of these is concerned with techniques of collecting information bearing on the solution of a health problem. Students should be taught to realize that collection of facts is not in itself necessarily a scientific procedure. In the collection of data on health as on other subjects there will always tend to be selection of facts in terms of the conceptual frame of the investigator in spite of efforts at objectivity. This can be well illustrated by the history of medicine, which is replete with erroneous theories whose proponents have been able to argue on the basis of selected evidence. Laboratory work and demonstrations are not in themselves sufficient as scientific proof, because they can be set up to prove erroneous theories. Anatomists before Vesalius, for example, dissected the human body to prove that Galen was right and not to find the actual characteristics of the human body.

The problem of proof in matters of health and disease is particularly complicated by the fact that the human body has its own devices for combating poisons and acquiring internal stability. As a result, many cures attributed to drugs would have taken place anyway, and sometimes take place

in spite of the use of drugs. Students should, therefore, be made aware of the complicated nature of scientific proof in medicine, where there are so many variables, and should be given illustrations of methods of control used in past and current medical studies in which a theory was proved or is being investigated. Some of Pasteur's controlled experiments, such as those with rabies and anthrax, are examples often used in this connection; and Sinclair Lewis' *Arrowsmith* presents the problem dramatically. Local or state medical agencies have, as a rule, studies recently completed or in process that can be used to indicate the care with which present-day medical theories are tested scientifically. From them and from his own preparation for the class a student may learn methods of defining the limits of a problem, of establishing procedures of research and sampling, of methods of interviewing and observation, and of construction of forms and questionnaires. He may also acquire ability to secure firsthand information by experiments, by distinguishing between variable and constant, or control, factors, to formulate procedures used in an experiment and the conditions under which it is to be operated, and to manipulate laboratory materials and equipment. The analysis of real situations and real problems rather than the teaching of abstract scientific method will have most fruitful educational results by enabling students to be scientific participants in the movement toward medical progress.

The student of health should learn to distinguish between true and false advertising of foods, drugs, and cosmetics; to evaluate such medical theories as the germ theory and the theory underlying present-day treatment of deficiency diseases; and to make other judgments on health. It is necessary, therefore, for him not merely to know how to collect evidence from valid sources and through controlled experiments, but also to interpret data and make reliable and valid generalizations. To do this he must have the ability (*a*) to distinguish between fact and assumption; (*b*) to determine whether the facts presented are really relevant to the problem as defined and whether the problem is defined adequately in terms of the data; (*c*) to discern consistencies and inconsistencies, accuracies and superficialities, in the data and in the hypothesis; (*d*) to be resourceful in developing alternative hypotheses and in checking conflicting authorities to account for the observed facts. All these scientific procedures require suspended judgment and recognition of the tentative nature of a medical hypothesis and of the dynamic quality of the growing body of scientific knowledge in medicine. But it is important that the scientific method not be identified with paralyzing indecision. One can never have *all* the facts in matters of health and one must judge and act upon the best knowledge available.

By means of the scientific method in medicine not only are causes established in terms of observed effects but effects are predicted in terms of established causes. It is this predictive aspect of the scientific process that has proved so important for modern medicine in the control of diseases. A goal of teaching in the field of health is, therefore, to illustrate the important fact that medical science is not merely theory and method but a beneficent guide to action.

Scientific progress in matters of health is dependent to a considerable degree on the accuracy of recording findings in medicine and public health. For this reason one of the objectives of teaching is to develop competence in expression and writing and skill in the preparation and interpretation of slides, diagrams, charts, and statistical tables. Medical journals give ample evidence of the great difficulties scientists have in presenting their achievements to the outside world because they have not been taught these skills. There are many opportunities for the science teacher to supplement the work of the English teacher in developing literary competence in the

process of discussing problems of health and disease. Likewise because much of the data fundamental to the subject of health are best presented numerically, it is essential that students learn to interpret tables and graphs on mortality and morbidity rates and to know the significant elements of their constructions. Many adults have developed a phobia on statistics and are frustrated and baffled by them. A presentation of statistical material in the natural course of a discussion of health problems will do much to overcome this difficulty, which now hampers full understanding and appreciation of medical progress.

In evaluation of the use of scientific methods and skill in research, objective tests may be designed to judge the ability to determine valid sources of information on health, familiarity with reliable sources, ability to interpret reading material and health advertisements and statistics relating to health. Several illustrative tests follow:

Example 1. To test students' understanding of the meanings of articles on health and their ability to judge the validity of authorities quoted.

Directions to students: Read the quotation and determine the author's meaning. Then, check (✓) statements in which author's opinions are expressed. Indicate whether statements you have checked are true (T) or false (F); check (✓) statements in the second group which express *your* opinion of the quotation.

Quotation: "Meat in wholesome condition does not cause any disease known to medical science. Meat infected with germs or parasites will cause food poisoning, but so will any other infected food. Nonpasteurized milk is responsible for more deaths than, perhaps, any other food, and it has caused many epidemics of sore throat and diphtheria. It has also caused thousands of cases of tuberculosis.

"Meat does not cause high blood pressure, hardening of the arteries, diseases of the kidneys or gout. We do not know the cause of these ailments. A physician forbids meat only when the kidneys are so severely damaged that they cannot excrete the waste products derived from meat." [2]

[2] From an article entitled "Meat in the Diet," *Health and Hygiene*, May, 1937; article not signed.

Statements

Group I

1. Meat is the most important cause of a large number of diseases. 1. ——
2. Food poisoning is sometimes caused by infected meat. 2. ——
3. Raw milk often carries disease germs. 3. ——
4. Meat is known to cause serious kidney diseases. 4. ——
5. Great numbers of people have contracted sore throat and diphtheria from the use of raw milk. 5. ——
6. Physicians believe that most people would be healthier if they refrained from eating meat. 6. ——
7. Contaminated raw milk has caused many cases of tuberculosis. 7. ——
8. Meat may be injurious to persons with diseased kidneys. 8. ——
9. Raw milk should never be consumed under any circumstances. 9. ——
10. The causes of high blood pressure and hardening of the arteries are unknown. 10. ——
11. Some of the wastes are removed from the blood by the kidneys. 11. ——
12. Meat is seldom contaminated with disease germs. 12. ——
13. Gout is caused by eating too much meat. 13. ——
14. Wholesome meat is difficult to obtain. 14. ——

Group II

1. The facts in this quotation are apparently correct. 1. ——
2. The author is probably expert in health matters. 2. ——
3. There are serious errors of fact in the quotation. 3. ——
4. The author is probably not an expert in health matters. 4. ——
5. The quotation is correct except for unimportant errors. 5. ——
6. The fact that the article is unsigned indicates that it is unreliable. 6. ——

Example 2: To test students' ability to discern what facts or concepts are assumed in a given conclusion.

Directions: In drawing a conclusion from any limited set of facts, it is always necessary to assume the existence of other facts. Check (✓) the statements which *must be proved true* before anyone can be certain that the conclusions given in the quotation are true. Do not check any statements unless they are *essential* to the conclusions given.

"Statistics of life insurance companies show that the death rate is higher for people who

drink alcoholic liquors habitually than it is for those who never use them."

Conclusion: Habitual use of alcoholic liquor shortens life.

Statements

1. Drinkers and nondrinkers are exposed to the same extent to disease and other causes of death except alcoholic liquor. 1. ——
2. Alcohol is a poisonous substance. 2. ——
3. The statistics of life insurance companies are accurate. 3. ——
4. A person who drinks habitually is likely to die young. 4. ——
5. People who drink occasionally are likely to die sooner than those who never drink. 5. ——
6. People who carry insurance are less likely to drink than other people. 6. ——
7. Life insurance companies insure sufficient numbers of drinkers and nondrinkers to make rates comparable. 7. ——
8. People should avoid alcoholic liquors. 8. ——

Example 3: Designed to distinguish between what advertisements actually say and what they seem to say.

Directions: Read advertisement. If a statement repeats what is *said* in the advertisement, encircle S; if it is only implied, encircle I.

"ANNOUNCING Vi-A-Dy EMULSION
(Vitamins A and D)

"Although it is more potent in vitamins A and D than ordinary cod-liver oil this new emulsion has

no fish-oil taste
no aftertaste
nor does it cause flatulence
(gas in the stomach)

On the contrary, it tastes like orange syrup and children lick the spoon and beg for more. It can be flooded over ice cream to make an 'orange sundae' and unsuspecting guests will pass their plates for second helps—it's been done!

"The special feature is the new fish-liver oil concentrate, derived from various fish (excluding cod) and balanced to a uniform high potency of vitamins A and D. Unlike cod-liver oil whose inherent rank taste bursts through all disguises, this concentrate is practically tasteless; the flavor of the emulsion is only that of the materials with which it is blended: malt, sugar, and natural orange juice.

"To conform with familiar dosage practice, Vi-A-Dy is so balanced that each teaspoonful contains the same number of units of vitamin D and vitamin A as a teaspoonful of the best grade of cod-liver oil."

Statements

S = Said
I = Implied

1. Vi-A-Dy emulsion is richer than ordinary cod-liver oil in vitamins A and D. S I
2. Ordinary cod-liver oil may cause gas on the stomach. S I
3. Vi-A-Dy has the flavor of oranges. S I
4. Most people would enjoy taking Vi-A-Dy. S I
5. A nearly tasteless concentrate of fish-liver oils rich in vitamins A and D is used in the manufacture of Vi-A-Dy. S I
6. The liver of the cod is not used in the manufacture of Vi-A-Dy. S I
7. Vi-A-Dy contains sugar and malt. S I
8. A teaspoonful of Vi-A-Dy is equivalent in vitamin A and D potency to a teaspoonful of cod-liver oil of the best grade. S I
9. Vi-A-Dy will not cause gas in the stomach. S I
10. Ordinary cod-liver oil has a fish-oil taste. S I

In addition to objective tests essay tests may be used to determine whether the students have learned to grasp the implications of the scientific methods involved in the materials discussed. Specific problems may be given, such as asking students to interpret the significance, from the point of view of scientific research, of the following paragraph:

"Collins pointed out in 1927 that the correlation of low-income status and high infant mortality rate seems to be independent of such factors as the age and nativity of the mother, age of the infant, order of birth, years of married life, and other disturbing factors which must be eliminated before valid comparisons can be made."

More general essay assignments may be made on the interpretation of radio programs dealing with research in medicine or reviews of books dealing with health problems.

EVALUATION OF ATTITUDES AND WORLD-VIEWS

An appraisal of teaching in the field of health involves an analysis of the degree to which irrational attitudes have been dis-

pelled. An attitude toward the human body can be developed through health education which leaves none of its functions ugly and vulgar. Proper instruction can overcome the feelings of shame and embarrassment for what are normal physiological processes; the vague insecurity that stems from fear of the results of illness, no matter how minor. It can likewise overcome the self-consciousness of students derived from their attitudes toward themselves because they think they are too tall, too short, too heavy, too thin, or have too much bodily hair. It revises their concept of what is normal and underscores the prevalence of a wide range of individual differences. Recklessness in handling diseases, which springs from ignorance and insecurity can be replaced by caution based on confidence. Obsessions and revulsions likewise can be overcome through very careful handling of health situations.

Some students conceal illnesses such as tuberculosis, syphilis, and even diabetes among members of their families as something unspeakably shameful. These attitudes of shame and secretiveness seriously impede the treatment and control of diseases, and therefore are problems for the science teacher. Much of the *crisis psychology* associated with illness can be dispelled by the teaching of deliberation and specific procedures in coping with diseases. Attitudes of thoughtful cooperation with the sick and the disabled can also be nurtured. A disposition to be tolerant of human fraility, without pampering invalidism, can be developed.

There has grown up over a long period of time attitudes toward the medical profession that are not conducive to a good patient-doctor relationship. Most of these attitudes have originated in earlier times when the medical profession had not attained the skills and professional status that it has since achieved through its advancing knowledge. Suspicion engendered by past failures, and ill will arising out of increased costs of medical care associated with new medical technology, have led to considerable disparagement of medical men. Quacks of all sorts take advantage of this ill will to promote their own monetary interests. A careful analysis of the reasons for the criticisms of the medical profession and of its extensive achievements for the welfare of mankind will do much to correct this situation. Fear of physicians, which accounts for some of the hostility to them, can be dispelled by knowledge of their instruments, techniques, and procedures. The lingering terror of hospitals as "vestibules of death" can be overcome by the students' acquaintance with the role the hospitals have played in the lowering of death rates. The attitudes with respect to immunization, quarantine, periodical medical examinations, government medical care, and expenditures of public money for hospitals and clinics depend very largely on knowledge of the facts involved and the development of students' ability to use scientific methods of collecting and appraising them.

The subject matter of the science of health lends itself to such presentation that students' views of their place in the world of nature and culture can become more mature. There develops a confidence in man's increasing power to combat by science the diseases that terrorized his ancestors. No longer is an epidemic or personal illness ascribed to the anger of an avenging God, as a punishment for sin. No longer is man fatalistic before mysterious death-dealing powers or awed by inexplicable recuperative powers of the human body.

Although it will become clear to students that knowledge in the field of health is far from complete, yet they will realize that available knowledge is sufficient to shatter the props of supernaturalism. As the edifice of supernaturalism collapses, a new structure of belief can replace it. In a scientific world-view the human organism is seen as part of a natural order and its functioning is recognized as explicable

without recourse to mysterious external forces. The recognition that man is but a part of a larger natural order, which is comprehensible, predictable, and potentially controllable in the interest of man's health, does not demean him but rather gives him new dignity.

The student can develop in his study of the science of health not merely an enriched appreciation of man's place in the natural order but also a deeper understanding of his social role. It can soon become clear, even to the novice in the field of health, that social backgrounds play an important role in health. When the British Ministry of Health made its report on the influenza epidemic following World War I, it made the significant comment that "no technical device of the sanitarian, no resource of the laboratory, can have any effect in the reduction of death and sickness from epidemic or even endemic disease at all commenseurate with the consequences which must follow a *universal* improvement of the standard and conditions of life." As has been shown facts have accumulated to show the correlation of high death and sickness rates with low incomes. The result is that the problem of health becomes one not merely of medical science and even of public health administration but also of social security in its larger sense.

It is here that a person's concept of his role as a producer, as a consumer, and as a citizen plays a part. A student may learn how labor and farmers' organizations have been instrumental in improving conditions by setting up safety standards and preventing excessive speed-up that causes overfatigue, how they have raised wage levels and enabled workers to enjoy better housing and more healthful living conditions; how these organizations along with civic groups have supported the passage of legislation that has improved health conditions of the entire population. He may learn too how many of the unions have set up their own group health plans to serve their members, and some employers have set up health services to improve the efficiency of their enterprises.

The student attains new perspectives on the place of the consumer in modern society in his study of health problems. He can observe the need for improvement in the present distribution of medical services, particularly in relation to the lower income groups and rural populations. Not only can he note the disparity between the knowledge of medical science and its extensive application because of costs, but he can become conscious of the present difficulties encountered in obtaining knowledge concerning the best medical services available. As a consumer, he will have particular need to develop sophistication in his analysis of the claims of advertisers for their drugs and elixirs and special foods and, through this, get broader insights into the separate functioning of our economy.

The problems involved in maintenance of health impinge directly upon the role of the citizen. The need for the state to intervene to protect community health even when it runs counter to individual freedom is being increasingly recognized as imperative. The student can acquire attitudes of social responsibility in observing quarantine laws, in avoiding spitting, in cooperating with immunization programs, and in a host of other ways such as observing health laws and regulations. He can learn the need for legislation that will put human welfare above property rights, for example, the condemnations of contaminated food, prevention of the sale of dangerous drugs, the razing of buildings that are hazardous, prevention of free movement of populations during epidemics, and debarment of quacks from practicing medicine. All these illustrations can help to broaden a student's understanding of the relationship of the individual to the government. It can become apparent to him that, in a democratic society, citizens can help to formulate health laws and bring pressure upon their repre-

sentatives for passage and for enforcement.

The protection of health brings man into the orbit of a citizen of the world. Local, state, and even Federal laws are not sufficient to guard against disease. Microbes and viruses are not respecters of national boundaries. Bubonic plagues in Asia, or typhus on the battlefields of Europe, or yellow fever in South America imperil all continents, for that which affects the health of any area may affect the economy as well as the health of the rest of the world. For this reason it was in health work that the United Nations Relief Administration has obtained some of its major successes in international collaboration. Moreover, the knowledge from which modern medical science derives its ability to cope with disease is the contribution of scientists of the whole world. The concept of world-citizenship and international responsibility may thus become a basic objective in the teaching of scientific principles and practices of promoting health and preventing disease.

These issues, which emerge from a study of health, can be presented to students in terms of specific problem situations as a means of evaluating their attitudes toward science in relation to society and to religion; attitudes toward government and politics as they affect the progress of medicine; attitudes toward wealth and property as they enter into the health situation; attitudes toward community loyalty and participation; attitudes toward the role of workers', farmers', and businessmen's organizations in health matters; attitudes toward international collaboration as a basis for the control of epidemics and for the interchange of medicinal knowledge.

An example of the manner in which attitudes can be ascertained on specific problems follows:

Problem: A man who is a typhoid carrier wants to work as a baker, the only trade he knows. The health department demands that he stop. What should be done?

Check (✓) answer you believe to be correct.

1. The man should be allowed to work as a baker.
2. There might be some danger to the public if the man worked as a baker, but probably this would not amount to much.
3. It would be reasonably dangerous to have the man work in a bakery, and he should be advised to learn another trade.
4. The man should not be allowed to work as a baker unless he could earn a living in no other way.
5. The man should not be allowed to work as a baker under any circumstances.

There are available a number of health attitude inventories that a teacher might wish to use to find out the health attitudes of his students when his classwork begins and to evaluate changes that have occurred over time, or the teacher might wish to prepare his own inventory based on thoughtful observation of the behavior of his students. The construction of attitude scales for anything approximating objective scoring is complicated and requires the help of an expert. However, it is of considerable value to the teacher to prepare, for himself, the raw materials for the construction of an attitude scale and in this way tentatively appraise the prevailing attitudes of his students.

The teacher may also evaluate changes in students' attitudes by anecdotal records and by periodic interviews with the students. They may be asked to write essays or conduct panel discussions or debates around the problems of health associated with the passing of fear, for example, on health superstitions; on what the conquest of epidemics contributes to the conquest of fear; on the significance of the decline of the death rate from pneumonia upon the fears of the sick; on the increasing skills of the medical profession, on how to avoid excitement when illness comes; on asepsis and the passing of fear of hospitals. Other topics might be on the problem of laissez faire and public health; on whether newspapers and radio chains should be prohibited from printing or broadcasting false or misleading advertising of foods, drugs, and medical quackeries; on how misunder-

standings between physicians and laymen might be resolved; whether the medical profession itself or government agencies should control health standards; on the degree to which the government should enter to improve the health of the populace; on the relation of income and health; on whether sanitation should be a government or private function; on how far one can depend upon education to regulate health or to what extent compulsion must be used on individuals to protect the general good; on whether health insurance should be voluntary or compulsory.

EVALUATION OF OVERT BEHAVIOR AND CONDUCT

Newly acquired knowledge of fact and concept, ability to collect and interpret data scientifically, and newly developed attitudes will help to influence students' overt behavior. In the field of health, however, there is often a wide disparity between knowledge and belief and action. The faith in traditional cures is great, and resistance to change in behavior is repeatedly rationalized by the remark: "What was good enough to cure my parents is good enough for me." When health practices and food tastes become habitual, changes are difficult to make. The financial costs of keeping well also deter many from utilizing the knowledge which they have acquired because of the expense of drugs, doctors' fees, and hospital charges. Traditional principles of individual freedom sometimes tend to interfere with ready cooperation with quarantine regulations and other public health measures.

Through observation and anecdotal records, the teacher will be able to evaluate the degree to which he has attained his objectives of overcoming these deterrents and of developing behavior patterns that promote individual and public health, along the following lines:

- Development of proper health habits relating to personal appearance, for example, correct posture, correct care of skin, scalp, hair, and teeth; the avoidance of *harmful* cosmetics, depilatories, deodorants.
- The proper planning of meals to include necessary vitamins, proteins, fats, carbohydrates, and minerals; proper preparation of foods to preserve values; rejection of foods promoted by false propaganda; the planning and execution of diets for emergency conditions such as anemia, underweight and overweight, diabetes, convalescence; the carrying out of doctor's orders on infants' diets.
- Cooperation in prevention of diseases of foods; avoidance of unpasteurized milk; insistence on proper government inspection of food processing and handling.
- Care in selecting source of drinking water to avoid typhoid.
- Development of proper habits of elimination and resistance to advertised claims of laxatives and special roughage foods.
- Rejection of advertised products for treating headaches, common colds, hay fever, and other diseases of the respiratory system; of patent drugs for "bad blood," blood pressure, varicose veins, and other circulatory diseases; of drugs for malfunctioning glands, and other unprescribed drugs and medicines.
- Proper rest habits to avoid fatigue poisons; the avoidance of unprescribed sedatives.
- The ability to apply first aid principles in an emergency and to treat minor ailments in the absence of a physician.
- The avoidance of injurious chemical and physical hazards at work and at home: for example, burns, lead, phosphorus, benzene, and mercury poisoning, silicosis, the deleterious effect of ultraviolet light on skin and eyes, sunstroke, electrical shock, industrial and home accidents.
- Choice of home with proper sanitation and lighting and with absence of congestion.
- Selection of the best medical care available in the community; use of available clinics and dispensaries; the avoidance of quacks and faddists.
- Collaboration with others to make health care more readily accessible to lower income groups through group hospital and medical plans.
- Active and ready cooperation with health authorities on immunization and sanitation programs.
- Cooperation with organizations seeking high wage and relief standards to eliminate malnutrition and reduce other diseases associated with, or increased by, low incomes.
- Cooperation with agencies seeking legislation to require factory sanitation and safety regulations to eliminate industrial accidents and occupational diseases.

— Collaboration with Federal social security programs, nutrition campaigns, and other plans of the Federal government to improve the health of the civilian population and of the armed forces.
— Support of volunteer health service agencies and scientific research in health through assistance in community fund drives.

It is somewhat difficult to evaluate the precise manner in which a community has been influenced by the health studies that teachers and students have planned and carried out. Yet the work done in the classroom, and through the classroom by publicizing the findings of students, may lead to significant changes over time. Because the students have served as agents in arousing public opinion, hospital and clinical facilities may be improved; better licensing standards may be obtained for the medical profession; and quacks may be prohibited from practicing; anti-vivisectionists may be prevented from interfering with scientific research; voluntary or compulsory group plans for medical care may be initiated; control of the water and food supply to prevent contamination may be tightened; garbage and sewage disposal may be improved; quarantine regulations may be more rigidly enforced; immunization programs may be carried out more thoroughly in normal periods and in addition more speedily in times of epidemics; state and local authorities may participate more fully in the Federal social security programs which provide for medical care and public health work; the ragweed menace may be eliminated; and relief provisions may be increased in order that relief recipients will not suffer from malnutrition; and a housing program may be initiated in a congested area. The results may not be manifested in direct advances of this sort but only in an awakening of improved public consciousness which may eventually lead to action, perhaps only when the students now in secondary schools become adult citizens.

CHANGING CONCEPTS IN EDUCATION

BLANCHE A. SCHINDELMAN
Elizabeth Irwin High School, New York, New York

THE first goal to be considered in education is *Education for a way of life in 1945*. When considering that in 1945, many words have new meanings and that many concepts have completely changed, one must try to realize what life is like from the point of view of the students. We, the teachers, must teach the new concepts although we may have learned the old.

The first word, the meaning of which has changed so much, is *race*. At one time there was the simple statement in a biology book. There are 3 races, based on color—White, Black, Yellow. Now we are more scientific in our biologic classifications. First, we must answer to ourselves, as well as to the children: What is a race? Are Jews a race? What is a nation? Are Jews and Negroes a nation? Can one speak of a racial type? What would that really mean? What is a typical Jew? a typical Negro? Is Rochester a typical Negro or is Paul Robeson? Is Harry Hirschfield a typical Jew or is Albert Einstein? All these questions and the half truths implied by them must be dealt with and substituted for in clearly defined new meanings. We must impress on our students that there is only one race, a human race and that all human beings show perhaps very different environmental traits but that all these differences are superficial and unimportant.

Shall we continue to accept the idea of a white man's burden? Is there anything at all in the idea of race supremacy? Probably all Americans would insist they do not

think so because when they answer they are thinking of Nazi race theories, but if one probes, he is very likely to find some feeling of superiority, due either to color, religion, education or even a street address. A good text book for high school classes which may be used in either English, Social Science or Biology is *Probing Our Prejudices* by Hortense Powdermaker, Assistant Professor of Anthropology at Queens College. In this she shows how prejudices start in early overheard conversations, in words not really understood but tones of voice giving them meaning. For example, if the first Jewish child you meet awakens in your memory your father's description of what a *JEW* did to him in his business, you are starting a relationship with a prejudice. You have a conviction this is such a child and you cannot trust him. Without that really little understood remark, you would have met the child with no prejudices and accepted the Jewishness as you would any other characterizations.

The time has now come too, when a teacher must take a stand. To say, "I will not propagandize," and let white children refuse to sit near Negro children because it is their "right" and you are "tolerant" is wrong. One hasn't the "right" to be incorrect in his attitudes. Such an attitude is analogous to eliminating the police force and saying a man has the right to drive through the streets at 80 miles an hour. Lincoln Steffens made the distinction between liberty and license. To live in a way that is free and cooperative and yet of your own choosing, that is liberty. To live as some of us do, at the cost of a Negro's pride and dignity as when he is segregated, that is license. A teacher must nip any incipient race supremacy manifested in the bud. But to do this she must understand that the negro children are her equal in every way.

Along with the changing ideas of race and prejudices, are changing outlooks and ideals of democratic living. Whereas at one time words like conservatism and isolationism were respectable words with meanings acceptable to everyone, though owned by only a few, today they are not even *acceptable*. Whereas at one time the Monroe Doctrine and Kipling's *East Is East and West Is West and Ne'er the Twain Shall Meet,* were ideas generally accepted, they have not stood the test of scientific reasoning or time. Wendel Willkie's *One World* has shown how it is just one world and that certainly the East and West have met in Yalta, San Francisco and Berlin.

Only by a thorough study of the effects of heredity and environment can one learn and teach the new interpretations of humanity—that every single individual is the result of the lives of other individuals, that competition is not the life of trade but that cooperation is, that all is not fair in war; these are only some of the new concepts to be learned, the basis for which must be laid in the Science room in first establishing our meanings of *RACE*.

A GREAT SCIENTIFIC "WORKING PARTY"

RITCHIE CALDER

Science Editor of the "News Chronicle" (London)

PUTTING the spirit of Anglo-American cooperation into practice, a treaty of alliance has been signed between those two great institutions, the Massachusetts Institute of Technology and the Imperial College of Science and Technology, London. They have agreed to work together and to interchange teachers and post-graduate students.

This is not just a sign of grace and courtesy or an amiable get-together. This is a "working party" which can mean a

lot to both countries. As the late Sir William Bragg, the British Nobel prize-winner, one said: "Pure, or long-distance science is international. At a scientific conference, nationality disappears. It is when the results of science have to be converted into business and trade that trouble begins." Well, here, pooling their experience, are two time-honored institutions which were set up to convert science into business and trade.

Although the Imperial College is now celebrating its centenary, the Massachusetts Institute, founded in 1861, can claim to be the older of the two. A hundred years ago, the Royal College of Chemistry was opened in London. It was the forerunner of the three colleges which were to be federated into the Imperial College, in 1907. In that year its charter brought it into line with its American "opposite-number," for it was charged with the duty of "providing the highest specialized instruction and the most advanced training and research, especially in its application to industry."

One would like to find a romance in the association of the two—like that which exists between those other two great institutions, the American Smithsonian Institute and the British Royal Institution. For the Smithsonian was founded by an Englishman, James Smithson, and the Royal Institution by an American, Benjamin Thompson. Smithson, a chemist, had a "chip on his shoulder." He was the illegitimate son of the first Duke of Northumberland and a woman of royal descent, and in his will establishing the Institute in a country he had never visited, he vowed "My name shall live in the memory of man when the title of Northumberland is extinct and forgotten." Benjamin Thompson (later Count Romford) was also a chemist, settled in Britain.

But the association between the Massachusetts Institute and the Imperial College is more prosaic—a mutual history of solid achievement.

The British member of the new partnership had, as the first President of that original Royal College of Chemistry, Prince Albert, Queen Victoria's consort. The aim of the college was to be "the prosecution of such researches as may become of public benefit and tend to the general advancement of this important science."

It was the Prince Consort who introduced Hofmann as the first professor of the College. Hofmann's isolation of benzene from coal-tar began the great era of coal-chemistry, which has now given us the vast dyestuff industry, the plastics industry, and the phenomenal advances in life-saving drugs, such as the sulfas.

One of Hofmann's students was W. H. (later Sir William) Perkin who discovered the aniline dyes, and started the chemical industry. Seventy years later, Dogmak working in Germany on red aniline dye was to produce "Prontosil" and open the way to the sulfanilamides and sulfanamides which, with penicillin, were to save hundreds of thousands of lives in World War II.

Another of Hofmann's students and one of his successors in the Chair of Chemistry, Sir William Tilden, first discovered the structure of isoprene, the foundation stone of synthetic rubber.

Professor Thomas Huxley became Professor of Biology in 1854. Darwin's great colleague in the battle of Evolution against the Fundamentalists was as brilliant in the classroom as he was in the debates in which he routed the clerics and became, to many, the Victorial Antichrist. He fired the imagination of one threadbare student who in 1884 joined his class—Mr. H. G. Wells.

Wells was then studying to become a teacher of science. He got his B. Sc. and he got the insight which was to make him the greatest and most prophetic of all writers on science. The earliest of his imaginative, but uncanny accurate, interpretations of science were published in the college magazine. In "Love and Mr. Lewisham" he gives a picture of college

life in Thomas Huxley's biological laboratory. And from the dizzy heights of his literary eminence, he still hankers after recognition as a qualified scientist; at the age of 77, he got his Doctorate of Science on a biological thesis. The College's most distinguished literary alumnus was too ill to take part in the centenary celebrations.

The Royal School of Mines, one of the colleges, was responsible for the development of Basic Bessemer and Basic Open Hearth processes for the manufacture of steel, through its researches on phosphoric iron ore. It initiated the science of metallography from the study of the crystalline study of metals.

Through its long history, it has been outstanding in its contributions to the development of scientific apparatus, instruments and techniques. It is part of the discipline of student-training that research workers must be proficient in making the tools they use. Activities range from plant and animal technology to aeronautics and atomic energy.

The Imperial College played a big part in the Allied war-effort. It has had international fame for its combustion research and fuel technology, and during World War II that was turned to account in the development of flame-throwers, of bombs and explosives, of aero-engines and conversely, in civil defense, where it helped in fire-prevention.

Researches on fog dispersal led to "FIDO" the method by which by means of gasoline-burners aircraft could be helped to take off or land on fog-bound airfields. They produced a fool-proof system, and "kept 'em flying."

Aeronautics has been a big feature in the College's work. It has made outstanding contributions to high-speed flight, both through the College researches and the brilliant research workers it has produced. Important work was done there on jet-propulsion.

Much of the work done during the war has not yet been disclosed, but its part in the atomic-bomb researches is now known.

Early in 1939, Sir George Thomson of Imperial College (later to become the chairman of the atomic committee set up by Mr. Churchill) urged the importance of intensive research on uranium fission. A ton of uranium was provided for the laboratory. The early results were similar to those obtained, independently, by Dr. Halban, working with Professor Joliot in Paris. Professor Peierls later suggested that the isolation of uranium 235 would make a great difference to the speed of the reaction and to the possibilities of producing atomic explosions on a big scale.

Sir George Thomson undertook the task of coordinating the atomic work which was going on also at Cambridge, Oxford, Liverpool and Birmingham. In the summer of 1941 he was able to report that there was a reasonable chance of the atomic bomb being produced before the end of the war and that substantial progress was being made.

Subsequently the results of the work and a large part of the staff of British scientists were sent to America to join forces with the scientists working on it there.

This kind of cooperation in war is now to be perpetuated in peace-time. Imperial College and Massachusetts Institute of Technology, both of them born of the First Industrial Revolution and the need for applying science to it, are going, as partners, into the Second Industrial Revolution, with all the vast possibilities that atomic energy has created.

SCIENCE READING MATERIALS FOR PUPILS AND TEACHERS IV

CLARENCE M. PRUITT
University of Illinois

GOOD books remain the most reliable guide to an understanding of contemporary society. Since this is *the Age of Science and Technology*, books relating to these fields offer the best, if not the sole, means to an understanding of today's world and tomorrow's future.

There has never been a time when every school library and every teacher was more in need of new science books. The present and the future belong to Science. Too often the smallest item in the school budget is alloted to books, and yet a well-selected library made use of by teachers and pupils is, perhaps, the best single adjunct to better teaching. And the better the teaching, the more reading and research are utilized. These call for reference books and supplementary materials that are sufficient and adequate.

This list of books covers the war years. One readily notes the effect of the war both in the titles and in the increased number of books relating to aviation and physics. Seemingly the war and the scarcity of paper and labor did not unduly lessen the number of science books published. A wealth of interesting, appealing, stimulating material is being written both for the pupil and the science teacher. An excellent science library for the high school pupil, the elementary pupil, and professionally for the teacher can be selected from the list of books to follow.

Illustrations, literary style, and photographs (many in color) are the best ever. What a contrast between elementary science books and the nature study books of a couple of decades ago! High school textbooks are improved similarly but to a less degree.

PART I

PUPIL REFERENCES

A. Astronomy

ANGELL, PAULINE K. When Today Began. Macmillan '42, 378 p. $0.92.

COLLINS, A. FREDERICK. The Greatest Eye in the World. Appleton '42, 266 p. $3.00.

FISHER, GEORGE CLYDE. Story of the Moon. Doubleday '43, 301 p. $3.00.

——— Exploring the Heavens. World Pub. '42, 289 p. $1.00.

REED, WILLIAM M. Stars for Sam. Harcourt '41, 190 p. $2.75.

SCOTT, ORAL E. The Stars in Myth and Fact. Caxton '42, 347 p. $3.00.

SKILLING, W. T., and RICHARDSON, ROBERT S. Sun, Moon and Stars. Whittlesey '45. $2.50.

WILLIAMS, LOU. A Dipper Full of Stars. Wilcox '44, 170 p. $2.00.

WOODBURY, DAVID. The Glass Giant of Palomar. Dodd '39, 368 p. $4.00.

WYLIE, CHARLES. Our Starland. Lyons '42, 378 p. $0.88.

B. Aviation

AREY, CHARLES K. The Airport. Macmillan '43, 35 p. $0.40.

——— Aviation Science for Boys and Girls. Macmillan '44, 229 p. $1.12.

Aviation Education Research Group, Teachers College, Columbia University. Science of Pre-Flight Aeronautics for High Schools. Macmillan '43, 791 p. $1.32.

Aviation Education Research Group, Teachers College, University of Nebraska. Elements of Pre-Flight Aeronautics for High School. Macmillan '43, 521 p. $0.96.

BAUER, HUBERT A. Globes, Maps, and Skyways. Macmillan '42, 75 p. $0.40.

BLACK, A. The Story of Flying. McGraw '40, 267 p. $2.75.

CARLISLE, NORMAN U. How Planes Fly. Harper '43, 64 p. $1.00.

——— et al. Wonder Book of the Air. Winston '45, 316 p. $2.50.

——— Air Forces Reader. Bobbs '44, 406 p. $3.75.

COHEN, ROSE. Flying High. Macmillan '42, 320 p. $0.76.

CONGER, ELIZABETH M. American War Planes. Holt '43, 161 p. $2.00.

CROSS, E. A. Wings for You. (Two series.) Macmillan '43, 303 p.; 351 p. $0.76 each.

DUNN, MARSHALL and MORISETT, LLOYD M. Wings for America. World '43, 244 p. $1.00.

FITZPATRICK, FREDERICK L. and STILES, KARL A. The Biology of Flight. Macmillan '43, 149 p. $0.64.

FRANCIS, DEVON. Aviation, What Everyone Should Know. Bobbs '45, 229 p. $2.50.

FRASER, CHELSEA. Heroes of the Air. Crowell '40, 888 p. $2.50.

GANN, ERNEST K. Getting Them Into the Blue. Crowell '42, 154 p. $2.00.

GREGORY, H. F. Anything a Horse Can Do: The Story of the Heliocopter. Reynal '44, 243 p. $3.00.

GRIMM, DOROTHY. Junior Aviation Science. Noble '42, 111 p. $0.90.

JORDANOFF, ASSEN. Jordanoff's Illustrated Aviation Dictionary. Harper '42, 415 p. $3.50.

KINERT, REED. America's Fighting Planes in Action. Macmillan '43, 142 p. $2.50.

LENT, HENRY B. Aviation Cadet. Macmillan '41, 175 p. $1.75.

LEY, WILLY. Rockets. Viking '44, 287 p. $3.00.

LEYSON, BURR. The War Plane and How It Works. Dutton '43, 224 p. $2.50.

——— American Wings. Dutton '43, 215 p. $2.00.

MCCLINTOCK, MARSHALL. Airplanes and How They Fly. Stokes '43, 94 p. $2.00.

MCDONALD, E. F., JR. Youth Must Fly: Gliding and Soaring for America. Harper '42, 221 p. $2.50.

OSTEYEE, GEORGE. Mathematics for Aviation. Macmillan '43, 186 p. $0.64.

OTT, LESTER. Aircraft Spotter. Harcourt '42, 64 p. $1.00.

POPE, FRANCIS and OTIS, ARTHUR S. Elements of Aeronautics. World '41, 660 p. $2.92.

RENNER, GEORGE T. and BAUER, HUBERT A. The Air We Live In. Macmillan '43, 41 p. $0.36.

ROBINSON, PEARL ET AL. Before You Fly. Holt '43, 568 p. $2.75.

SCOTT, COL. ROBERT LEE. Runway to the Sun. Scribner '45, 218 p. $2.50.

SKILLING, WILLIAM and RICHARDSON, R. S. The Practical Essentials of Pre-Training Navigation. Holt '42, 75 p. $0.75.

VELTER, ERNEST. Visibility Unlimited. Morrow, 352 p. $4.00.

WEBBER, WALTER B. Aeronautical Instrument Projects for Junior Aviation Classes. McKnight '45, 124 p. $1.20.

ZIM, HERBERT S. Man in the Air. '43, 332 p. $3.00. Air Navigation. '43, 324 p. $3.00. Submarines. '42, 306 p. $3.00. Parachutes. '42, 252 p. $2.50. Rockets and Jets. '45, 326 p. $3.00. Harcourt.

C. Biology

AKELEY, CARL. The Wilderness Lives Again. Dodd '40, 411 p. $3.00.

ARMSTRONG, E. H. Bird Display. Macmillan '42, 381 p. $5.50.

BAYNE, G. S. Getting to Know the Birds. Collins '44, 102 p. $2.50.

BEATY, JOHN Y. Luther Burbank: Plant Magician. Messner '43, 251 p. $2.50.

——— Nature Is Stranger Than Fiction. Lippincott '41, 286 p. $2.50.

BIGGER, JOSEPH W. Man Against Microbes. Macmillan '39, 304 p. $2.50.

BRONSON, WILFRID S. The Chisel-Tooth Tribe. Harcourt '39, 200 p. $2.00.

——— Grasshopper Book. Harcourt '43, 127 p. $1.75.

——— Horns and Antlers. Harcourt '42, 143 p. $2.00.

——— Children of the Sea. Harcourt '40, 264 p. $2.00.

BRIDGES, WILLIAM. Big Zoo. Viking '41, 160 p. $2.00.

BUCK, FRANK. Jungle Animals. Random '45, 55 p. $1.50.

——— and WELD, CAROL. Animals Are Like That. McBride '39, 240 p. $2.50.

——— and FRASER, F. L. All in a Lifetime. McBride '41, 277 p. $2.75.

BUCK, MARGARET. Animals Through the Year. Rand '41, 96 p. $2.00.

CAHALANE, VICTOR H. Meeting the Mammals. Macmillan '43, 133 p. $1.75.

DEMPEWOLFF, RICHARD. Animal Reveille. Doubleday '43, 272 p. $3.00.

DEVOE, ALAN. Down to Earth: A Naturalist Looks About. Coward '40, 228 p. $2.50.

EBERLE, IRMENGARDE. Wide Fields: The Story of Henry Fabre. Crowell '43, 193 p. $2.50.

EDEY, MAITLAND. American Water Birds, Also Hawks, Owls and Gamebirds. Random '41, 72 p. $1.00.

——— American Song Birds. Random '40, 72 p. $1.00.

EDWARDS, DOROTHY. All About Elephants. Dutton '41, 88 p. $1.50.

EVANS, EDNA. Bill and the Bird Binder. Winston '40, 220 p. $1.50.

FAIRCHILD, L. H. and FAIRCHILD, HELEN. Cats and All About Them. Orange '42, 231 p. $2.00.

FENTON, CARROL LANE. Our Living World. Doubleday '43, 312 p. $4.50.

FULLER, RAYMOND T. Now That We Have to Walk: Exploring the Out of Doors. Dutton '43, 256 p. $2.50.

GABRIELSON, IRA N. Wildlife Refugees. Macmillan '43, 257 p. $4.00.

GAER, JOSEPH. Men and Trees. Harcourt '39, 118 p. $1.25.

GAUL, A. T. Picture Book of Insects. Lothrop '43, 41 p. $1.00.

GRIMES, CHARLES W. A Story Outline of Evolution. Humphries '45, 244 p. $2.00.

GRISCOM, LUDLOW. Modern Bird Study. Harvard '45, 190 p. $2.50.

HEADSTROM, R. Adventures with a Microscope. Stokes '41, 232 p. $2.00.

HOLME, BRYAN. The Book of Animals. Studio '40, 96 p. $1.50.

HOOGSTRALL, HARRY. Insects and Their Stories. Crowell '41, 144 p. $2.00.

HYLANDER, CLARENCE JOHN. World of Plant Life. Macmillan '42, 722 p. $3.95.

JAEGER, ELLSWORTH. Wildwood Wisdom. Macmillan '45, 491 p. $2.95.

KENLY, JULIE CLOSSON. Voices from the Grass. Appleton '40, 248 p. $2.00.

KNIGHT, RUTH. Valiant Comrades. Doubleday '43, 238 p. $2.00.

LAWRENCE, C. H. and BJOLAND, ESTHER. The Pond World. Garden '40, 72 p. $1.25.

LEY, WILLY. Days of Creation. Viking '41, 275 p. $2.75.

——— Lungfish and the Unicorn. Viking '41, 305 p. $2.75.

LINTON, RALPH and ADELIN. Man's Way. Harper '45. $2.50.

LINTZ, GERTRUDE. Animals Are My Hobby. McBride '42, 301 p. $2.75.

LUCAS, JANNETTE. Fruits of the Earth. Lippincott '42, 72 p. $2.00.

——— Indian Harvest: Wild Food Plants of America. Lippincott '45, 118 p. $2.00.

MCCRACKEN, HAROLD. Last of the Sea Otters. Stokes '42, 98 p. $2.00.

MCKENNY, MARGARET. Book of Wayside Fruits. Macmillan '45, 78 p. $2.50.

MASON, GEORGE F. Animal Tracks. Morrow '43, 95 p. $1.50.

MASON, MIRIAM E. Young Audubon: Boy Naturalist. Bobbs '43, 198 p. $1.50.

MATSCHAT, CECILE. American Butterflies and Moths. Random '42, 70 p. $1.00.

MAUGHN, SIDNEY. Earth's Green Mantle. Macmillan '39, 322 p. $3.50.

MINOT, JOHN C. The Best Animal Stories I Know. Wilcox '45. $1.00.

——— The Best Bird Stories I Know. Wilcox '45. $1.00.

NEEDHAM, JAMES. Introducing Insects. Cattell '40, 129 p. $1.50.

PEATTIE, DONALD C. A Gathering of the Birds. Dodd '39, 379 p. $3.00.

PERKINS, R. MARLIN. Animal Faces. Foster '44, 92 p. $1.50.

PERRY, JOSEPHINE. The Cotton Industry. '43, 128 p. $1.75.

——— Fish Production. '40, 104 p. $1.75.

——— and SLAUSON, CELESTE. Milk Production. 119 p. $1.75.

——— Forestry and Lumbering. '45, 128 p. $1.75. Longmans.

PICKWELL, GAYLE. Animals in Action. '40, 190 p. $4.00.

——— Birds. '39, 252 p. $3.50.

——— Deserts. '39, 174 p. $3.50. Whittlesey.

REGLI, ADOLPH. Rubber's Goodyear: The Story of Man's Perseverance. Messner '41, 248 p. $2.50.

——— The Mayos: Pioneers in Medicine. Messner '42, 248 p. $2.50.

SANDERSON, I. T. Animals Nobody Knows. Viking '40, 77 p. $2.00.

——— Living Treasure. Viking '41, 290 p. $3.50.

SHAW, MARGARET and FISHER, JAMES. Animals as Friends and How to Keep Them. Dutton '40, 271 p. $2.00.

SNYDER, EMILY E. Biology in the Making. McGraw '40, 539 p. $2.80.

STANDEN, ANTHONY. Insect Invaders. Houghton '43, 228 p. $3.00.

TEALE, EDWIN. Near Horizons, the Story of an Insect Garden. Dodd '42, 319 p. $3.75.

——— Boy's Book of Insects. Dutton '39, 237 p. $2.00.

——— Golden Thong, A Book About Bees. Dodd '40, 208 p. $3.00.

——— Byways to Adventure. Dodd '42, 222 p. $2.75.

——— Grassroot Jungles, A Book of Insects. Dodd '44, 240 p. $3.75.

THONE, FRANK. The Microscopic World. Messner '40, 245 p. $3.00.

TREW, CECIL G. The Story of the Dog and His Uses to Mankind. Dutton '40, 193 p. $2.50.

TRUAX, RHODA. Joseph Lister, Father of Modern Surgery. Bobbs '44, 287 p. $3.50.

VERRILL, A. HYATT. Perfumes and Spices, Soaps and Cosmetics. Page '40, 304 p. $3.00.

——— Strange Animals and Their Stories Page '39, 235 p. $2.75.

———Wonder Creatures of the Sea. Appleton '40, 272 p. $3.00.

——— Wonder Plants and Plant Wonders. Appleton '39, 296 p. $3.00.

WALDEK, THEODORE. Jambra, the Elephant. Viking '42, 224 p. $2.00.

WOLFE, LINNIE. Son of the Wilderness. Knopf '45, 364 p. $3.50.

WOOD, L. N. Raymond Ditmars, His Exciting Career with Reptiles, Animals and Insects. Messner '45, 272 p. $2.50.

——— Walter Reed, Doctor in Uniform. Messner '43, 277 p. $2.50.

YATES, RAYMOND F. Fun With Your Microscope. Appleton '43, 150 p. $2.00.

D. Chemistry

BAKER, R. RAY. So That's Chemistry. Reilly '40, 128 p. $1.00.

COLLINS, A. FREDERICK. The Boy Chemist. Odyssey '45, 341 p. $2.75.

——— Wonders of Chemistry. Crowell '42, 315 p. $2.00.

CARLISLE, NORMAN. Your Career in Chemistry. Dutton '43, 251 p. $2.50.

CURIE, EVE. Madam Curie. Garden '39, 412 p. $1.59.

EBERLE, IRMEGARDE. Radium Treasures and the Curies. Crowell '42, 105 p. $2.00.

FREEMAN, MAE and IRA. Fun with Chemistry. Random '44, 58 p. $1.25.

GALDSTON, IAGO. Behind the Sulfa Drugs. Appleton '43, 174 p. $2.00.

HIBBEN, THOMAS. The Sons of Vulcan: The Story of Metals. Lippincott '40, 259 p. $2.00.

HOLBROOK, STEWART. Iron Brew. Macmillan '39, 352 p. $3.00.

HOLMES, HARRY N. Out of the Test Tube. Emerson '43, 311 p. $3.00.

HORNING, JOHN L. and MCGINNIS, G. C. An Open Door to Chemistry. Appleton '45. $2.00.

JACKSON, ANN and JACKSON, D. E. Wonders of Oil. Dodd '40, 146 p. $2.00.

KENDALL, JAMES. Young Chemists and Great Discoveries. Appleton '40, 272 p. $2.75.

LANDIS, WALTER S. Your Servant, the Molecule. Macmillan '44, 238 p. $2.75.

LEGGETT, WILLIAM F. The Story of Linen. Chemical '45, 103 p. $2.75.

LEYSON, BURR. Plastics in the World of Tomorrow. Dutton '44, 184 p. $2.50.

MCCARTHY, JAMES R. Fire in the Earth, the Story of the Diamond. Harper '42, 263 p. $2.50.

METCALFE, JUNE M. Copper, the Red Metal. Viking '44, 104 p. $2.00.

MORGAN, ALFRED. Getting Acquainted with Chemistry. '42, 271 p. $3.00.

——— Simple Chemical Experiments. '41, 260 p. $2.00.

——— Things a Boy Can Do With Chemistry. '40, 198 p. $2.00. Appleton.

OFFNER, MONROE. Fundamentals of Chemistry and Their Applications in Modern Life. Blakiston '44, 408 p. $0.69.

PARKER, CHARLES M. Steel in Action. Cattell '43, 221 p. $2.50.

PERRY, JOSEPHINE. The Steel Industry. '43, 126 p. $1.75.

——— The Chemical Industry. '44, 128 p. $1.75.

——— The Glass Industry. '45, 128 p. $1.75.

——— The Coal Industry. '44, 128 p. $1.75. Longmans.

STRACK, LILLIAN. Asbestos. '41, 56 p. $1.00.

——— Nickel. '41, 46 p. $1.00.

——— Radium. '41, 53 p. $1.00 Harper.

WEEKS, ELVIRA. Discovery of the Elements. Journal '45, 578 p. $4.00.

WOLFE, BERNARD. Plastics. Bobbs '45, 189 p. $2.50.

YATES, RAYMOND E. Atom Smashers. Didier '45, 182 p. $2.00.

ZANETTI, J. ENRIQUE. Fire from the Air, the A B C of Incendiaries. Columbia '42, 54 p. $0.50.

E. General

ANDREWS, ROY CHAPMAN. Under a Lucky Star. Viking '43, 300 p. $3.00.

ANONYMOUS. Youth Looks at Science and War. Science Service '42. $0.25.

——— Boy's Fun Book of Things to Make and Do. Foremost '45, 192 p. $1.49.

BAER, M. E. Rain or Shine: The Story of Weather. Farrar '40, 292 p. $2.00.

BAITY, ELIZABETH. Man Is a Weaver. Viking '42, 354 p. $2.50.

BURLINGAME, ROGER. Whittling Boy, the Story of Eli Whitney. Harcourt '41, 370 p. $3.00.

CARLISLE, NORMAN V. Your Career in Engineering. Dutton '42, 253, p. $2.50.

——— Your Career in Transportation. Dutton '42, 188 p. $2.50.

——— and LATHAM, F. B. Miracles Ahead. Macmillan '44, 288 p. $2.75.

COFFMAN, R. P. and GOODMAN, N. G. Famous Explorer for Boys and Girls. Barnes '42, 166 p. $2.00.

COHN, DAVID L. Combustion on Wheels. Houghton '44, 272 p. $2.75.

COLLINS, A. FREDERICK. Science on Parade. Appleton '40, 314 p. $3.00.

——— Science for Young Men. Appleton '45. $2.50.

COMPTON, RAY and NETTLES, CHARLES H. Conquests of Science. Harcourt '39, 378 p. $1.75

CONKLIN, GOFF. All About Houses. Messner '39, 194 p. $2.00.

COOLEY, DONALD G. Your World Tomorrow. Duell '44, 252 p. $2.50.

CUSHING, HARVEY. The Medical Career. Little '40, 302 p. $2.50.

DU PONT, ALEXIS F. Under Sea with Helmet and Camera. Dodd '40, 87 p. $2.50.

ELLSBERG, EDWARD. Hell on Ice. Dodd '39, 365 p. $3.00.

——— Men Under the Sea. Dodd '39, 365 p. $3.00.

FAST, HOWARD. Goethals and the Panama Canal. Messner '42, 230 p. $2.50.

FENTON, CARROLL L. and FENTON, MILDRED. The Story of the Great Geologists. Doubleday '45, 301 p. $3.50.

——— Mountains. Doubleday '42, 160 p. $2.50.

——— Earth's Adventures. Day '42, 207 p. $2.40.

——— Our Amazing Earth. Garden '43, 346 p. $1.49.

FILIPIAK, ANTHONY. 100 Puzzles and How to Make Them. Barnes '42, 120 p. $1.00.

FISHBEIN, MORRIS. Do You Want to Become a Doctor? Stokes '39, 176 p. $1.50.

FISHER, CLYDE ET AL. Marvels and Mysteries of Science. Wise '41, 818 p. $2.95.

FLOHERTY, JOHN J. Behind the Microphone. '44, 207 p. $2.00.

——— Money-Go-Round: The Strange Story of Money. '44, 189 p. $2.00.

——— Flowing Gold: The Romance of Oil. '45. $2.50. Lippincott.

FREEMAN, IRA M. Invitation to Experiment. Dutton '40, 238 p. $2.50.

FREEMAN, MAE and IRA. Fun with Science. Random '43, 60 p. $1.00.

GARBEDIAN, H. GORDON. George Westinghouse: Fabulous Inventor. Dodd '43, 235 p. $2.50.

GRAHAM, SHIRLEY and LIPSCOMB, GEORGE D. George Washington Carver, Scientist. Messner '44, 248 p. $2.50.

GREGORY, TAPPAN. Eyes in the Night. Crowell '39, 243 p. $3.40.

HAMILTON, EDITH. Mythology. Little '42, 497 p. $3.50.

HATCH, ALDEN. Glenn Curtis: Pioneer of Naval Aviation. Messner '42, 294 p. $2.50

HENRY, MARGUERITE. Robert Fulton, Boy Craftsman. Bobbs '45, 187 p. $1.50.

HYLANDER, CLARENCE J. American Scientists. Macmillan '43, 186 p. $2.50.

JUDSON, C. I. Soldier Doctor: Story of William Gorgas. Scribners '42, 151 p. $1.60.

LEEMING, JOSEPH. Fun With Magic. Stokes '43, 86 p. $2.00.

LEYSON, BURR. Careers in the Steel Industry. Dutton '45, 191 p. $2.00.

MCCLINTOCK, MARSHALL. The Story of War Weapons. Lippincott '45, 173 p. $2.50.

MCDONALD, LUCILE. Jewels and Gems. Crowell '40, 288 p. $1.00.

MACMILLAN, WILLIAM. Arctic Adventure. Mill '45, 192 p. $2.00.

MILLER, FRANCIS T. Thomas A. Edison. Winston '40, 320 p. $1.50.

MINOT, JOHN C. The Best Stories of Exploration I Know. Wilcox '45. $1.00.

MONTGOMERY, ELIZABETH. Story Behind Great Inventions. McBride '44, 254 p. $2.00.

MUSSEY, JUNE B. Magic. Barnes '42, 83 p. $1.00.

NELSON, EUGENE W. The Magic Wand of Science. Dutton '39, 213 p. $2.00.

PATTERSON, JOHN C. America's Greatest Inventors. Crowell '43, 240 p. $2.00.

POLLACK, PHILIP. Careers in Science. Dutton '45, 222 p. $2.75.

REED, W. MAXWELL. America's Treasure. '39, 395 p. $3.00.

——— Earth for Sam. '41, 390 p. $2.75.

——— and BRONSON, W. S. Sea for Sam. '41, 360 p. $2.75. Harcourt.

REYNOLDS, NEIL B. and MANNING, E. L. Excursions in Science. Whittlesly '39, 307 p. $2.50.

RIFKIN, LILLIAN. When I Grow Up, I'll Be a Doctor. Lothrop '43, 44 p. $1.25.

ROGERS, AGNES. From Men to Machines. Little '41, 160 p. $2.50.

STEVENSON, AUGUSTA. George Carver, Boy Scientist. Bobbs '44, 202 p. $1.50.

STEELE, EVELYN M. Careers for Girls in Science and Engineering. Dutton '43, 189 p. $2.50.

THOMAS, W. STEPHEN. Amateur Science. Norton '42, 291 p. $2.75.

TRAIN, A. The Story of Everyday Things. Harper '41, 428 p. $3.50.

TUOMEY, DOUGLAS. The Home Mechanic. Macmillan '43, 182 p. $2.50.

VAN METRE, T. W. Trains, Tracks and Travel. Simmons '43, 417 p. $3.50.

WHEELER, HAROLD F. Marvels of the Modern World. Halcyon '40, 448 p. $1.98.

YATES, RAYMOND. Machines Over Men. Stokes '39, 249 p. $2.50.

——— Science with Simple Things. Appleton '40, 245 p. $2.50.

——— Science Calls to Youth. Appleton '41, 205 p. $2.00.

YOST, EDNA. Modern Americans in Science and Inventions. '41, 270 p. $2.00.

——— American Women of Science. '43, 232 p. $2.00. Stokes.

F. Physics

ALMSTEAD, FRANCIS E. ET AL. Radio: Fundamental Principles and Practices. McGraw '44, 219 p. $1.80.

ANONYMOUS. Artificial Light and Its Applications. Westinghouse '40, 296 p. $1.25.

BENDICK, JEANNE. Electronics for Boys and Girls. McGraw '44, 148 p. $1.75.

BENZ, FRANCIS. Talking Round the Earth. Dodd '42, 233 p. $2.00.

COE, DOUGLAS. Marconi, Pioneer of Radio. Messner '43, 272 p. $2.50.

COLLINS, ARCHIE F. How to Understand Electricity. Blakiston '44, 326 p. $0.69.

DUNLAP, O. E. Future of Television. Harper '42, 194 p. $2.50.

DUNN, M. L. and MORRISETT, L. N. Machines for America. World '43, 164 p. $0.80.

——— Power for America. World '43, 164 p. $0.80.

EDDY, WILLIAM C. Television: The Eyes of Tomorrow. Prentice '45, 330 p. $3.75.

HARRISON, G. R. How Things Work. Morrow '41, 301 p. $2.75.

HYLANDER, CLARENCE J. and HARDING, ROBERT. Introduction to Television. Macmillan '41, 207 p. $2.00.

LEYSON, BURR. It Works Like This. Dutton '42, 224 p. $2.50.

MEYER, JEROME S. The A B C of Physics. Dial '44, 346 p. $3.50.

MILLER, DAYTON C. Sparks, Lightning, Cosmic Rays. Macmillan '39, 192 p. $2.50.

MORGAN, ALFRED. The Boy Electrician. Lothrop '40, 403 p. $3.50.

——— Getting Acquainted with Electricity. Appleton '42, 346 p. $3.00.

——— The Pageant of Electricity. Appleton '39, 363 p. $3.50.

——— Getting Acquainted with Radio. Appleton '40, 285 p. $2.50.

——— First Radio Book for Boys. Appleton '44, 192 p. $2.00.

NEIL, HUMPHREY. Forty-Eight Million Horses. Lippincott '40, 214 p. $2.50.

PEET, CREIGHTON. How Things Work. Holt '41, 116 p. $2.00.

PENNY, A. C. Everyday Electricity and Magnetism. Longmans '43, 248 p. $1.75.

PERRY, JOSEPHINE. The Electrical Industry. Longmans '45, 128 p. $1.75.

RECK, FRANKLIN M. Radio from Start to Finish. Crowell '42, 160 p. $2.00.

——— Automobiles from Start to Finish. Crowell '41, 100 p. $2.00.

ROGERS, AGNES. From Man to Machine: A Pictorial History of Invention. Little '41, 160 p. $2.50.

SMALL, SIDNEY A. and CLARKE, CHARLES R. Simplified Physics. Dutton '43, 428 p. $3.00.

WILLIAMS, R. E. and SCARLOTT, CHARLES. Radio. American '43, 282 p. $1.48.

YATES, RAYMOND F. A Boy and a Battery. Harper '43, 120 p. $1.50.

——— Boy's Book of Communication. Harper '42, 144 p. $2.00.

——— Young Men and Machines. Dodd '44, 196 p. $2.00.

——— Boy's Book of Magnetism. Harper '41, 166 p. $2.00.

——— Fun with Electronics. Appleton '45, 159 p. $2.75.

G. Junior High

BENCHLEY, BELL. My Animal Babies. Little '45, 264 p. $3.00.

BRINDZE, RUTH. The Gulf Stream. Vanguard '45, 63 p. $2.50.

BRONSON, WILFRED S. The Grasshopper Book. Harcourt '43, 128 p. $1.75.

BRUERE, MARTHA. Your Forests. Lippincott '45, 159 p. $2.50.

BULFINCH, THOMAS and SEWELL, HELEN. Book of Myths. Macmillan '42, 126 p. $2.00.

CONKLIN, GROFF. All About Subways. Messner '39, 212 p. $2.00.

COTHERN, MARION. Pigeon Heroes. Coward '44, 147 p. $2.00.

——— Buried Treasure: the Story of America's Coal. Coward '45, 63 p. $1.50.

CUMLEY, RUSSELL W. America's Oil. Row '42, 48 p. $0.32.

DAVIS, ROBERT H. Let's Go with Bob Davis. Appleton '40, 452 p. $3.00.

DE SOLA, RALPH. Bird Book. '41, 58 p. $0.50.

——— Reptile Book. '41, 59 p. $0.50.

——— Zoo Book. '41, 59 p. $0.50. Whitman.

DITMARS, RAYMOND. Animal Kingdom: Way of Life in Zoo. Row '41, 64 p. $0.96.

——— Book of Zoography. Cadmus '40, 64 p. $1.32.

——— Strange Animals I Have Known. Harcourt '39, 375 p. $2.19.

DUNHAM, MIRIAM. What's in the Sky. Oxford '41. $1.00.

DU PUY, WILLIAM. Our Insect Friends and Foes. '40, 284 p. $1.00.

——— Our Bird Friends and Foes. '40, 328 p. $0.80.

——— Our Plant Friends and Foes. '41, 290 p. $1.00. Winston.

FENTON, CARROLL and MILDRED. The Land We Live On. Doubleday '44, 89 p. $2.50.

——— Along Nature's Highways. Day '43, 96 p. $1.25.

FLEXNER, HORTENSE. Chipper. Stokes '41, 47 p. $1.00.

GLOVER, KATHERINE. America's Minerals. Row '41, 48 p. $0.32.

GUBERLET, MURIEL L. The Seashore Parade. Cattell '42, 197 p. $1.75.

HOGNER, DOROTHY and NILS. Farm Animals. Oxford '45, 194 p. $3.50.

HOLBROOK, STUART. Tall Timber. Macmillan '41, 179 p. $1.50.

HUEY, E. G. What Makes the Wheels Go Round? Reynal '40, 175 p. $2.50.

HUNGERFORD, EDWARD. Locomotives on Parade. Crowell '40, 236 p. $2.50.

HUNT, LYNN B. Interesting Birds of Our Country. Garden '45, 32 p. $1.50.

HUNTINGTON, HARRIET. Let's Go Outdoors. Doubleday '41, 89 p. $2.00.

——— Let's Go to the Seashore. Doubleday '41. $2.00.

JANSSEN, RAYMOND. Burning Sunlight, the Story of Coal. Row '41, 36 p. $0.28.

JOHNSON, GAYLORD. How Father Time Changes the Animals Shapes. Messner '39, 183 p. $2.00.

——— The Story of Earthquakes and Volcanoes. Messner '39, 144 p. $2.00.

JUDSON, CLARA. Railway Engineer. Scribners '41, 171 p. $1.50.

KANE, HENRY B. The Tale of a Bullfrog. Knopf '41. $1.50.

KING, ELEANOR and PESSELS, W. Working with Nature. Harper '39, 181 p. $1.20.

LE MAY, GERALDINE. The Story of a Dam. Longmans '40, 66 p. $1.50.

LEYSON, BURR. Aeronautical Occupations. '41, 187 p. $2.00.

——— Automotive Occupations. '41, 190 p. $2.00.

——— Photographic Occupations. '40, 178 p. $2.00. Dutton.

MCCRACKEN, HAROLD. Son of the Walrus King. Lippincott '44, 128 p. $2.50.

MCCREERY, J. L. Exploring the Earth and Its Life in a History Museum. Stokes '40, 312 p. $2.50.

MATTHEWS, FRANKLIN K. The Boy Scout Yearbook of Wild Animal Stories. Appleton '40, 295 p. $2.50.

MEADOWCRAFT, ENID L. Benjamin Franklin. Crowell '41, 190 p. $2.00.

MEYER, DICKEY. Planes in Action. Harper '44, 64 p. $1.00.

——— How Planes Get There. Harper '44, 64 p. $1.00.

NEVILLE, LESLIE (ED.). Aviation Dictionary for Boys and Girls. McGraw '44, 192 p. $2.00.

NICOLAY, HELEN. The Bridge of Water: the Story of the Panama Canal. Appleton '40, 295 p. $2.00.

ORR, GERTRUDE. Here Come the Elephants. Caxton '43, 208 p. $2.50.

NOVIKOFF, ALEX. Climbing Our Family Tree. International '45, 96 p. $1.85.

PARKER, BERTHA ET AL. Ask the Weatherman; Balance in Nature; Beyond the Solar System; Earth's Changing Surface; Earth's Nearest Neighbor; Fire, Friend and Foe; Heat; Insect Friends and Enemies; Insect Societies; Life Through the Ages; Light; Our Ocean of Air; Soil; The Sun and Its Family; The Ways of the Weather. Row '41. $0.32 each.

PATCH, EDITH M. and FENTON, CARROL L. Prairie Neighbors. Macmillan '40, 161 p. $1.75.

PERRY, JOSEPHINE. Fish Production. '40, 104 p. $1.75.

——— Coal Industry. '44, 128 p. $1.75.

——— Rubber Industry. '41, 128 p. $1.75.

——— and SLAUSON, CELESTE. Forestry and Lumbering. '39, 125 p. $1.75. Longmans.

PETERSHAM, MAUDE and MISKA. The Story Book of Cotton; The Story Book of Wool; The Story Book of Rayon; The Story Book of Silk. Winston '39. $0.75 each.

PRATT, MARGARET. When I Grow Up, I'll Be a Teacher. Lothrop '44, 44 p. $1.00.

RIFKIN, LILLIAN. When I Grow Up, I'll Be a Flyer. Lothrop '43, 40 p. $1.00.

ROBINSON, WILLIAM. At the Seashore. Macmillan '42, 40 p. $2.00.

——— At the Zoo. Macmillan '40. $2.00.

SCHOENEN, HERMANN. The Story Behind Steel. Knopf '44, 94 p. $1.75.

SETON, ERNEST THOMPSON. Seton's Trail and Campfire Stories. Appleton '40, 155 p. $1.00.

——— Wild Animals I Have Known. Scribners '42, 298 p. $2.00.

SEYMOUR, FLORA. Bird Girl: Sacagawea. Bobbs '45, 187 p. $1.50.

SORENSON, FRANK and ROTTER, G. E. Now We Fly. Winston '44, 184 p. $1.50.

SPITZ, ARMAND. The Pinpoint Planetarium. Holt '40, 86 p. $2.00.

STEARNS, D. M. Sniffy, the Story of a Skunk. '40, 64 p. $1.00.

——— Chuckle, the Story of a Woodchuck. '39. $1.00.

——— Whisk, the Story of a Chipmunk. '41. $1.00. Farrar.

PART II

PUPIL TEXTBOOKS AND WORKBOOKS

A. Biology Textbooks

BAKER, ARTHUR O. and MILLS, LEWIS. Dynamic Biology. Rand '43, 822 p. $2.28.

BAYLES, ERNEST and BURNETT, R. WILL. Biology for Better Living. Silver '41, 749 p. $2.28.

BENEDICT, RALPH C., KNOX, WARREN W. and STONE, GEORGE K. Life Science. Macmillan '41, 682 p. $2.08.

BURNETT, R. WILL. To Live in Health. Silver '44, 332 p. $1.96.

BUSH, GEORGE ET AL. A Biology of Familiar Things. American '39, 695 p. $2.08.

CURTIS, FRANCIS D., CALDWELL, OTIS W. and SHERMAN, N. H. Everyday Biology. Ginn '43, 698 p. $2.16.

DAFROSE, SISTER M. Biology for High Schools. Kennedy '42, 796 p. $2.40.

DOWNING, ELLIOT R. and MCATEE, VEVA M. Living Things and You. Lyons '41, 671 p. $1.96.

GRUENBERG, BENJ. C. and BINGHAM, N. E. Biology and Man. Ginn '44, 719 p. $2.24.

HUNTER, GEORGE W. Life Science. American '41, 803 p. $2.08.

MOON, T. and MANN, P. B. Biology. Holt '41 $2.12.

PAYNE, MARY. Biology Season by Season: For Catholic High Schools. American '43, 675 p. $2.32.

RITCHIE, JOHN W. Biology and Human Affairs. World '41, 1026 p. $2.32.

SMITH, ELLA T. Exploring Biology. Harcourt '43, 619 p. $2.24.

WEYMOUTH, CLINTON G. Science of Living Things. Holt '41, 534 p. $1.84.

WHEAT, FRANK M. and FITZPATRICK, F. General Biology. American '42, 566 p. $1.76.

B. Biology Workbooks

BAILEY, GUY A. and GREENE, R. A. New Laboratory Manual for New Biology. Allyn '42, 287 p. $0.75.

BURNETT, R. WILL and BLACKWOOD, P. E. Laboratory and Workbook Activities in Biology. Silver '43, 256 p. $0.92.

BUSH, GEORGE L. Activities for Biology of Familiar Things. American '39, 252 p. $0.48.

CALDWELL, OTIS W., CURTIS, FRANCIS D. and SHERMAN, N. H. Workbook to Accompany Everyday Biology. Ginn '43. $0.84.

DAY, C. W. and RITCHIE, MARGARET. Studies and Activities in Biology. World '42, 218 p. $0.80.

DOWNING, ELLIOT R. and MCATEE, VEVA M. New Learning Guide in Biology. Lyons '42, 319 p. $1.00.

HUNTER, GEORGE W. and KITCH, L. W. Activities in Life Science. American '42, 362 p. $0.88.

KROBER, E. and WOLFF, W. Workbook for Adventures with Living Things. Heath '40, 191 p. $0.72.

MANK, HELEN. Adventures in Thinking. Sanborn '44. $0.96.

MOON, T. ET AL. Biology Laboratory Manual. Holt '39. $0.80.

SMITH, ELLA T. and WEBBER, L. M. Exploring Biology Workbook. Harcourt '44, 154 p. $1.00.

VANCE, B. B. ET AL. Biology Workbook. Lippincott '41, 316 p. $0.92.

C. Chemistry Textbooks

AHRENS, M. M., BUSH, N. F. and EASLEY, R. K. Living Chemistry. Ginn '42, 528 p. $2.28.

BLACK, N. H. and CONANT, J. B. New Practical Chemistry as Applied to Modern Life. Macmillan '42, 683 p. $2.20.

BROWNLEE, RAYMOND ET AL. Chemistry in Use. Allyn '39, 688 p. $1.35.

——— Elements of Chemistry. Allyn '43, 712 p. $1.48.

DULL, CHARLES. Modern Chemistry. Holt '42, 604 p. $2.00.

GREER, CARLOTTA and BENNETT, J. C. Chemistry. Allyn '39, 861 p. $1.80.

HOGG, JOHN C. ET AL. Chemistry, a Course for High Schools. Van Nostrand '45, 544 p.

HOPKINS, B. S. ET AL. Chemistry and You. Lyons '44, 818 p. $1.80.

JAFFE, BERNARD. New World of Chemistry. Silver '41, 691 p. $1.84.

KRUH, F. O., CARLETON, R. H. and CARPENTER,

F. F. Modern Life Chemistry. Lippincott '41, 774 p. $1.92.

MCPHERSON, WILLIAM ET AL. Chemistry at Work. Ginn '42. $2.00.

WILSON, SHERMAN and MULLINS, MARY. Applied Chemistry. Holt '39, 530 p. $1.72.

D. Chemistry Workbooks

AHRENS, M. R. ET AL. Laboratory Problems. Ginn '42. $0.80.

AMES, M. U. and JAFFEE, B. Laboratory and Workbook Units in Chemistry. Silver '40, 267 p. $0.92.

BROWNLEE, R. B. Laboratory Experiments in Chemistry. Allyn '43, 376 p. $0.75.

——— Laboratory Experiments for Chemistry in Use. Allyn '39, 297 p. $0.60.

CARPENTER, F. F. and CARLETON, R. H. Comprehensive Units in Chemistry. Lippincott. $1.80.

DULL, CHARLES. Laboratory Exercises in Chemistry. Holt '43, 221 p. $0.76.

HOGG, JOHN C. ET AL. Workbook for Chemistry. Van Nostrand '45, 272 p.

HOPKINS, B. SMITH. Chemistry and You in the Laboratory. Lyons '39. $0.88.

MCGILL, M. V. and BRADBURY, G. M. Chemistry Guide and Laboratory Exercises. Lyons '44, 374 p. $1.00.

MCPHERSON, WILLIAM. Chemistry Workbook. Ginn '42. $0.88.

TULEEN, L. F. ET AL. Test It Yourself. Scott '41, 294 p. $0.96.

WILSON, S. R. Activity Notebook in Chemistry and Physics for Consumers. Holt '41, 102 p. $0.72.

E. Physical Geography

FINCH, V. C., TREWARTHA, G. T. and SHEERER, N. H. The Earth and Its Resources. McGraw '41, 634 p. $2.40.

FLETCHER, GUSTAV L. Earth Science. Heath '43, 583 p. $2.20.

F. Geography

BRADLEY, JOHN H. World Geography. Ginn '45, 486 p. $2.48.

CASE, EARL C. and BERGSMARK, DANIEL C. Modern World Geography. Lippincott '43, 746 p. $2.20.

CHAMBERLAIN, JAMES. Air-Age Geography and Society. Lippincott '44, 717 p. $2.12.

COLBY, CHARLES CARLYLE and FOSTER, ALICE. Economic Geography. Ginn '44, 685 p. $2.12.

ENGELHARDT, N. L., JR. Toward New Frontiers of Our Global World. Noble '43, 140 p. $2.00.

PACKARD, L., OVERTON, B. and WOOD, BEN D. Our Air Age World. Macmillan '44, 838 p. $2.80.

RIDGLEY, D. C. and EKBLAW, S. E . Influence of Geography on Our Economic Life. Gregg '43, 658 p. $1.84.

VAN CLEEF, EUGENE. Global Geography for High Schools. Allyn '44, 418 p. $1.48.

G. Physics Textbooks

BEAUCHAMP, WILBUR and MAYFIELD, JOHN C. Basic Electricity. Scott '43, 312 p. $1.60.

BENJAMIN, THEODORE D. Fundamentals of Electricity. Scribners '43, 256 p. $1.20.

BLACK, N. H. and DAVIS, H. N. Elementary Practical Physics. Macmillan '41, 710 p. $1.32.

BOWER, E. O. and ROBINSON, E. P. Dynamic Physics. Rand '42, 854 p. $2.32.

CARLETON, ROBERT H. Vitalized Physics in Graphicolor. College '44, 378 p. $0.80.

——— Vitalized Fundamentals of Machines. College '44, 186 p. $0.60.

CLARK, JOHN A. ET AL. Fundamentals of Machines. Houghton '43, 299 p. $1.24.

——— Physics Today. Houghton '43, 688 p. $2.00.

CORNETET, W. H. and FOX, D. W. Principles of Electricity. McKnight '43, 255 p. $1.60.

CUSHING, BURTON L. Fundamentals of Machines. Ginn '43, 434 p. $1.24.

DULL, CHARLES. Modern Physics. Holt '45, 623 p. $2.00.

——— and IDELSON, MICHAEL N. Fundamentals of Electricity. Holt '43, 456 p. $1.48.

——— and NEWLIN, I. G. Fundamentals of Machines. Holt '43, 547 p. $1.48.

FLETCHER, GUSTAV L. ET AL. Unified Physics. McGraw '43, 713 p. $1.80.

FULLER, ROBERT W. ET AL. Elements of Physics. Allyn '44, 831 p. $1.48.

HOLLEY, CLIFFORD and LOHR, V. C. Mastery Units in Physics. Lippincott '39, 701 p. $1.88.

IDELSON, M. N. and DULL, C. E. Mastery Units in Physics. Colonial '42. $0.68.

JOHNSON, WILLIAM H. and NEWKIRK, L. V. Fundamentals of Electricity. Macmillan '42, 212 p. $1.32.

JOSEPH, ALEXANDER. Fundamentals of Machines. Scribners '43, 255 p. $1.20.

LIEBOWITZ, S. H. Pre-Service Course in Machine Science. Wiley '43, 440 p. $2.50.

LUNT, JOSEPH R. and WYMAN, W. F. Electricity for Everyone. Macmillan '43, 649 p. $2.56.

LYNDE, CARLETON J. Everyday Physics. Macmillan '43, 577 p. $2.56.

MARCUS, A. and MARCUS, W. Elements of Radio. Prentice '43, 669 p. $4.00.

MASSON, LOUIS T. Physics Made Easy. Garden '39, 384 p. $1.49.

MILLER, FRED R. Fundamentals of Electricity. Heath '43, 220 p. $1.00.

MILLIKAN, ROBERT ET AL. New Elementary Physics. Ginn '44. $1.80.

OBOURN, ELLSWORTH S. and MONTGOMERY, GAYLORD C. Fundamentals of Machines. Webster '43, 218 p. $0.72.

——— Fundamentals of Electricity. Webster '43, 194 p. $0.96.

RINDE, CHARLES A. Electricity and Its Application to Civilian and Military Life. Harcourt '43, 466 p. $1.96.

SHEA, WILLIAM C. Pre-Service Course in Electricity. Wiley '43, 276 p. $2.00.

Staff of Carnegie Steel Corporation. Fundamentals of Electricity. American '43, 194 p. $1.16.

——— Fundamentals of Radio. American '43.

STEWART, O. M. and CUSHING, B. L. Physics for Secondary Schools. Ginn '41, 760 p. $2.00.

VERWIEBE, FRANK L. ET AL. Elements of Machines. Van Nostrand '43, 272 p. $1.24.

WALLENDORF, CHARLES R. ET AL. Machines. American '43, 300 p. $1.24.

WHITMAN, WALTER G. Household Physics. Wiley '39, 436 p. $3.00.

WILLARD, LESTER R. Fundamentals of Electricity. Ginn '43, 351 p. $1.24.

——— and WINTER, CHARLES S. Experiences in Physics. Ginn '43, 662 p. $2.12.

H. Physics Workbooks

BLACK, N. H. New Laboratory Experiments in Practical Physics. Macmillan '45. $1.60.

——— and WEAVER. Workbook and Laboratory Manual. Macmillan. $1.12.

BUELL, M. H. and SCHULER, F. W. Daily Life Workbook in Physics. Lippincott '39, 378 p. $1.20.

DAVIS, IRA and HOLLEY, CLIFFORD. Physics Guide and Laboratory Activities. Lyons '44, 310 p. $1.08.

DULL, CHARLES. Physics Workbook. Holt '40. $0.96.

FULLER, ROBERT W. ET AL. Laboratory Exercises in Physics. Allyn '45, 302 p. $0.75.

GALE, HARRY R. Physics Workbook and Laboratory Guide. Ginn '44, 394 p. $0.84.

HENDERSON, W. D. Physics Guide and Laboratory Exercises. Lyons '45, 360 p. $1.08.

MILLIKAN, ROBERT ET AL. Workbook in Physics. Ginn '44. $0.84.

STEWART, O. M. and CUSHING, B. L. Workbook in Physics. Ginn '41. $0.92.

TULEEN, LAWRENCE F. Prepare Yourself. Scott '43, 298 p. $0.96.

TURNER, HALLIE and MASSON, LOUIS. Your Experiment Guide in Physics. College '40, 151 p. $0.60.

I. Physical Science and Consumer Science

EBY, GEORGE S. ET AL. The Physical Sciences. Ginn '43, 493 p. $2.28.

CARLETON, ROBERT H. and WILLIAMS, HARRY H. Modern Life Science. Lippincott '42, 650 p. $2.40.

ECKELS, CHARLES F. ET AL. Our Physical World. Sanborn '39, 801 p. $2.20.

HAUSRATH, ALFRED H. and HARMS, JOHN H. Consumer Science: A Fusion Course in Physical Science Applied to Consumer Problems. Macmillan '39, 692 p. $2.40.

——— Let's Investigate. Macmillan '42, 154 p. $0.80.

NETTELS, CHARLES ET AL. Physical Science. Heath '42, 464 p. $2.24.

WILSON, S. R. Activity Notebook in Chemistry and Physics for Consumers. Holt '41, 102 p. $0.72.

J. General Science Textbooks

BEAUCHAMP, WILBUR; MAYFIELD, JOHN C. and WEST, JOE YOUNG. Science Problems, Book I. 432 p. $1.40; Science Problems, Book II. 578 p. $1.60; Science Problems, Book III. 756 p. $1.80; Everyday Problems in Science. 752 p. $1.84. Scott '40.

CALDWELL, OTIS W. and CURTIS, FRANCIS D. Everyday Science. Ginn '43, 664 p. $1.96.

CARPENTER, HARRY A.; SMITH, PAUL and WOOD, GEORGE C. Our Environment: Its Relation to Us. Allyn '42, 471 p. $1.12; Our Environment: How We Adapt Ourselves to It. '43, 622 p. $1.20; Our Environment: How We Use and Control It. '40, 846 p. $1.48; Our Environment: The Living Things in It. '39, 1079 p. $1.96.

CARROLL, FRANKLIN B.; REXFORD, F. A. and WEED, H. T. Understanding Our Environment. 438 p. $160; Understanding Our World. 554 p. $1.72; Understanding the Universe. 712 p. $1.84. Winston '43.

CLARK, JOHN A.; FITZPATRICK, FREDERICK L. and SMITH, EDITH L. Science on the March, Book I. 249 p. $1.40; Science on the March, Book II. 340 p. $1.40; Science on the March, Book III. $1.60; Science on the March. '44, 619 p. $1.92. Houghton.

DAVIS, IRA C. and SHARPE, RICHARD W. Science, a Story of Progress and Discovery. Holt '43, 495 p. $1.84.

DULL, CHARLES; MANN, P. B. and JOHNSON, P. G. Modern Science: Book I, In Our Environment. 432 p. $1.52; Book II, In Our Daily Life. 502 p. $1.68; Book III, In Man's Progress. 598 p. $1.92. Holt '43.

FOWLER, GEORGE W. ET AL. Our Surroundings. Iroquois '43, 757 p. $1.80.

HARRISON, J. M. Elementary General Science Books I, II, III. Longmans '39, 304 p. $1.40; '41, 247 p. $1.60.

HODGDON, DANIEL R. and SACHS, M. N. Creative Science. Book I. 282 p. $1.16; Book II. 332 p. $1.32; Book III. 522 p. $1.80. Hinds '39–'40.

HUNTER, GEORGE W. and WHITMAN, WALTER G. Problems in General Science. American '44, 688 p. $1.38.

LAKE, CHARLES H. ET AL. Exploring the World of Science. Silver '39, 710 p. $1.80.

MEISTER, MORRIS; KEIRSTEAD, RALPH and SHOEMAKER, LOIS. The Wonderworld of Science. Book 7. 353 p. $1.44; Book 8. 352 p. $1.44; Book 9. $1.44. Scribners '44–'45.

PIEPER, CHARLES J. and BEAUCHAMP, WILBUR. Everyday Problems in Science. Scott '40, 742 p. $1.72.

POWERS, SAMUEL RALPH; NEUNER, ELSIE F. and BRUNER, HERBERT B. Exploring Our World. '40, 496 p. $1.08; Our World Changes. '40,

565 p. $1.26; Using Our World. '41, 626 p. $1.92; Our World and Science. 654 p. $1.76. Ginn '41–'42.

REH, FRANK and WHEAT, FRANK. Science and Life. Books I and II. 406 p. $1.20; Books III and IV. 496 p. $1.48; Books V and VI. 661 p. $1.80. American '39–'43.

SKILLING, W. T. Tours Through the World of Science. McGraw-Hill '41, 815 p. $1.70.

SMITH, VICTOR C. and TRAFTON, GILBERT H. Exploring Science. 458 p. $1.40; Enjoying Science. 596 p. $1.60; Using Science. 802 p. $1.80. Lippincott '42.

WATKINS, RALPH K. and PERRY, WINIFRED. Understanding Science, Book I. 432 p. $1.28; Science for Daily Use, Book II. 500 p. $1.48; Science for Human Control, Book III. 588 p. $1.68. Macmillan '40.

K. General Science Workbooks

BOYER, PHILIP A. ET AL. Experiences in General Science—7th, 8th and 9th Grade. Lyons '45, 174 p.; 241 p.; 228 p. $0.68; $0.76; $0.92.

CALDWELL, OTIS W. and CURTIS, FRANCIS D. Workbook for Everyday Science. Ginn '43. $0.68.

CARPENTER, HARRY H.; SMITH, PAUL and WOOD, GEORGE C. Science Discovery Books. Book I. '42, 160 p. $0.45; Book II. '43, 237 p. $0.60; Book III. '40, 320 p. $0.72; Book IV. '39, 320 p. $0.72. Allyn.

DULL, CHARLES; MANN, P. B. and JOHNSON, P. G. Guidebook to Book I. $0.44; Guidebook to Book II. $0.48; Guidebook to Book III. $0.56. Holt '43.

ERNEY, FRED G. and MCALLISTER, JUNIA E. The Age of Science. Steck '43, 144 p. $0.55.

FOWLER, GEORGE W. and THURSTON, E. L. Laboratory Guide in General Science. Iroquois '45. $0.80.

HUDSPETH, JACK and HUDSPETH, FRANCES. Elementary Science Book 7. Steck '39, 120 p. $0.35.

LOVE, CURTIS and CLARK, JOHN A. Workbook to Accompany Book III. Houghton. $0.88.

POWERS, SAMUEL RALPH ET AL. Directed Activities I. $0.42; Directed Activities II. $0.45; Directed Activities III. $0.48. Ginn '40–'41.

TRAFTON, G. H. and SMITH, V. C. General Science Workbook. Lippincott. $1.00.

WATKINS, RALPH K. and PERRY, WINIFRED. Workbook to Science for Understanding Science. $0.48; Workbook to Science for Daily Use. $0.68; Workbook to Science for Human Control. $0.76. Macmillan '40.

WEIDNER, DOUGLAS. A General Science Workbook. Cattell '42, 216 p. $1.00.

PART III

ELEMENTARY SCIENCE

A. Primary Grades

BEAUCHAMP, WILBUR ET AL. Look and Learn. '43, 72 p. $0.84.

——— All Around Us. '44, 88 p. $0.96. Scott.

BRICE, TONY. Baby Animals. Rand '45, 12 p.

BRONSON, WILFRID S. Pollywiggles Progress. Macmillan '45. $2.50.

BROWN, MARGARET. Baby Animals. Random '41. $0.50.

CARPENTER, HARRY A. ET AL. Adventures in Science with Judy and Joe. 96 p. $0.54; Adventures in Science with Bob and Don. 144 p. $0.60; Adventures in Science with Jane and Paul. 192 p. 0.66. Allyn '44.

CHARTERS, W. W.; SMILEY, DEAN F. and STRANG, RUTH. All Through the Day. 178 p. $0.96; Health Through the Year. 180 p. $0.88; Health Secrets. 242 p. $0.92. Macmillan '41.

CRAIG, GERALD S.; BURKE, AGNES and BABCOCK, M. F. We Want to Know. 126 p. $0.57.

——— and BURKE, AGNES. We Find Out. 223 p. $0.60.

——— and BALDWIN, S. E. Changes All Around Us. 286 p. $0.66.

——— Our Earth and Sky. 292 p. $0.72. Ginn '40–'41.

DITMARS, RAYMOND. Twenty Little Pets from Everywhere. Messner '43, 64 p. $2.50.

DUPLAIX, GEORGES. Animal Stories. Simon '44, 91 p. $1.50.

ETS, MARIE H. In the Forest. Viking '44. 45 p. $1.00.

FRASIER, GEORGE W. and DOLMAN, HELEN. We See. $0.40; Sunshine and Rain. $0.60; Winter Comes and Goes. $0.84; The Seasons Pass. $0.96. Singer '39.

HALL-QUEST, OLGA W. Fuzzy-Wuzzy. Bobbs '41, 98 p. $1.25.

HOKE, HELEN and THORNE, DIANA. Shep and the Baby; Doctor, the Puppy Who Learns; The Shaggy Pony; The Furry Bears; The Fuzzy Kitten; The Wooley Lamb. Messner '41–'44, $1.25 each.

HUBER, MIRIAM; SALISBURY, F. S. and GATES, A. I. Planes for Bob and Andy. Macmillan '43, 352 p. $1.12.

HUDSPETH, JACK and HUDSPETH, FRANCES. Elementary Science Books 2 and 3. Steck '40. $0.25 each.

KNOX, WARREN W. ET AL. The Wonderworld of Science. Book I. '40, 128 p. $0.84; Book II. '40, 160 p. $0.92; Book III. '40, 197 p. $1.00. Scribners '40.

LENT, HENRY B. Straight Up. Macmillan '44, 86 p. $0.72.

——— Straight Down. Macmillan '44, 96 p. $0.72.

MACK, NILA. Animal Allies. Messner '42. $1.00.

MELLEN, IDA. Twenty Little Fishes. Messner '42, 53 p. $2.00.

MEYER, JEROME. Picture Book of Astronomy. Lothrop '45, 36 p. $1.75.

NEWBERRY, CLARE. Pandora. Harper '44. $1.75.

PARKER, BERTHA M.; BLOUGH, GLENN O. ET AL. Animals and Their Young; Animals

Round the World; Animals That Live Together; An Aquarium; Birds in the Big Woods; Doing Work; How the Sun Helps Us; The Insect Parade; The Pet Show; Plants Round the Year; Useful Plants and Animals; Water Appears and Disappears. Row. $0.32 each.

PEASE, JOSEPHINE and FRIEND, ESTHER. This Is the World. Rand '45. $2.50.

ROBINSON, W. W. and IRENE. At the Zoo. '40. $2.00; At the Seashore. '42, 40 p. $2.00; On the Farm. '39, 40 p. $2.00. Macmillan.

WOOLEY, CATHERINE. I Like Trains. Harper '44. $1.00.

B. Intermediate Grades

AREY, CHARLES K. Aviation Science for Boys and Girls. Macmillan '44, 229 p. $1.12.

BACON, PEGGY. The Lion-Hearted Kitten and Other Stories. Macmillan '41 102 p.

BAKER, R. RAY. So That Is Chemistry? Reilly '40, 128 p. $1.00.

BEATTY, JOHN. The Mountain Book. Cardy '44, 239 p. $0.90.

BEAUCHAMP, WILBUR; MELROSE, MARY and BLOUGH, GLENN. Discovering Our World. Book I. $0.96; Book II. $1.04; Book III. $1.12. Scott '39.

BRITTON, KATHERINE. What Makes It Tick? Houghton '43, 232 p. $2.50.

BROCK, EMMA. Mr. Wren's House. Knopf '44, 63 p. $1.25.

BRONSON, WILFRED S. Turtles. Harcourt '45. $1.75.

CARLISLE, NORMAN U. How Planes Are Made. Harper '45. $1.00.

CARPENTER, HARRY ET AL. Adventures in Science with Billy and Doris. 256 p. $0.66; Adventures in Science with Jack and Jill. 320 p. $0.75; Adventures in Science with Ruth and Jim. 414 p. $0.90. Allyn '44.

CHARTERS, W. W.; SMILEY, DEAN F. and STRANG, RUTH. Health Secrets and Health Ways and Let's Be Healthy; and Habits Healthful and Safe. Macmillan, 418 p.; 555 p. $1.24 and $1.40.

COHEN, ROSE N. The Men Who Gave Us Wings. Macmillan '44, 210 p. $1.08.

CRAIG, GERALD S. and HURLEY, B. J. D. Earth and Life Upon It. 368 p. $0.78.

——— CONDRY, M. G. and HILL, K. E. From Sun to Earth. 439 p. $0.84.

——— JOHNSON, G. M. and LEWIS, J. E. Earth, Then and Now. 480 p. $0.87. Ginn '40.

DE SOLA, RALPH. The Book of Birds; The Book of Reptiles; The Book of Wild Animals. Whitman '41, 58, 59 p. $0.50 each.

FENTON, CARROLL L. Weejack and His Neighbors. Day '44, 128 p. $1.75.

GALL, ALICE and CREW, FLEMING. Flat Tail. Oxford '41, 126 p. $1.00; Bushy Tail. Oxford '41, 164 p. $1.00; Wag Tail. Cadmus '41, 131 p. $0.96.

FRAZIER, GEORGE W. and DOLMAN, HELEN. The How and Why Club. $1.04; How and Why Experiments. $1.16; How and Why Discoveries. $1.28. Singer '39–'40.

GABLE, CHARLES H. and QUILLIN, E. S. Book of Along the Creek; Book of Feathered Flights; Book of Finding Nature's Treasures; Book of Little Creatures with Many Legs; Book of from Seed to Tree; Book of Queer Animals; Book of Thin Wings. Whitman '44. $0.50 each.

GLEESON, MARGARET. How Big? McKay '45. $0.75.

HETHERSHAW, LILLIAN and BAKER, TUNIS. Wonders to See. World '42, 284 p. $1.00.

HUDSPETH, JACK and HUDSPETH, FRANCES. Elementary Science Books 4, 5, 6. Steck '40. $0.35 each.

HYLANDER, CLARENCE JOHN. Outdoors in Autumn. '42, 131 p. $1.50.

——— Outdoors in Winter. '43, 146 p. $1.50.

——— Outdoors in Spring. '42, 143 p. $1.50.

——— Outdoors in Summer. '42, 142 p. $1.50. Macmillan.

ILIN, M. How the Automobile Learned to Run. International '45, 32 p. $1.25.

KAUFFMAN, ERLE. Kingdom of the Trees. Reilly '40, 122 p. $2.00.

KNOX, WARREN ET AL. The Wonderworld of Science. Book 4. 224 p. $1.08; Book 5. 256 p. $1.16; Book 6. 288 p. $1.28. Scribners '41.

LANG, DON. On the Dark of the Moon. Oxford '43, 235 p. $2.00.

LAWSON, ROBERT. Rabbit Hill. Viking '44, 127 p. $2.00.

LENSKI, LOIS. Little Farm. '42, 48 p. $0.75.

——— Little Train. '40. $0.75.

——— Animals for Me. '41, 48 p. $0.75. Oxford.

LOWRY, JANNETTEE. In the Morning of the World. Harper '44, 168 p. $2.00.

MALONEY, TOM. Judy at the Zoo. U. S. Camera '45. $1.00.

MELROSE, MARY and KAMBLY, P. E.. Plants and Animals Live Together. '42, 48 p.; Would You Have Liked to Lived When? '41, 32 p.

——— and Others. Nature's Bank, the Soil. '42, 48 p.

——— Raindrops and Muddy Rivers. '41, 32 p. Wilcox. $0.72 each.

MEYER, JEROME. Picture Book of Astronomy. Lothrop '45, 36 p. $1.75.

NEILSON, FRANCES. The Donkey from Dorking. Dutton '42, 85 p.

PARKER, BERTHA; BLOUGH, GLENN ET AL. The Air About Us; Animal Travels; Animals of Yesterday; Animals of the Seashore; Animals We Know; Birds; Clouds, Rain and Snow; Dependent Plants; Earth a Great Store House; Electricity; Fire; Fishes; Flowers, Fruits, Seeds; The Garden and Its Friends; Garden Indoors; Gravity; Insects and Their Ways; Living Things; Machines; Magnets; Plant and Animal Partnerships; Plant Factories; Reptiles; Saving Our Wild Life; Seeds and Seed Travels; The Sky Above Us; Soil; Sound; The Scientist and His Tools; Stories Read from Rocks; Thermometers, Heat and Cold; Toads and Frogs; Trees; Water; What Things Are Made Of; You as a Machine. Row. $0.32 each.

(Continued in March issue)

BOOK REVIEWS

UNIVERSITY OF THE STATE OF NEW YORK. *Health Teaching Syllabus for the Junior and Senior High Schools.* Albany: The University of the State of New York Press, 1944. 284 p.

This Syllabus is in keeping with a Regents regulation passed in September, 1942 requiring the teaching of health in the high schools of the state. In general this and other Regents regulations require: (1) that the *elementary school* curriculum shall include health teaching for all pupils which shall be carried on by the regular classroom teachers; (2) that in the *junior high school* grades provision shall be made for health teaching either as a part of a broad science program or as a separate course; (3) that in the *senior high schools* there shall be one or more courses in health carrying one unit of credit given by teachers with approved preparation, and further that a member of each senior high school faculty shall serve as health coordinator to encourage cooperation of the entire faculty in obtaining health emphasis in the school program; (4) that the staff of each *senior high school* shall plan a program including instruction in adjustment of the schools' environment to the needs of pupils with special attention to the health of individuals and cooperation with parents and in community health activities.

The bulk of this Syllabus is given over to detailed outline material. In the introductory section it is stated that the Syllabus contains the material for the basic course work in health required by the Regents. The materials have been prepared as a cooperative enterprise by representatives of several organizations. The major consideration for each senior high school unit has been the selection of goals most likely to result in improved health practices of pupils. Greater emphasis is placed on hygiene, physiology, and anatomy at the junior high school level. The philosophy of the cooperating organizations is indicated by statements such as the following: "Some health teaching is now going on in connection with courses in biology, home economics, general science and other subject areas. There is need for coordination, however, to avoid wasteful duplication of instruction, but the health field is so rich in materials that such duplication can be avoided readily. It is expected, therefore, in addition to the basic health teaching, that all teachers of courses containing health implications will continue to contribute to the health understandings of their pupils." It is pointed out that, while all teachers have an interest in the health of their pupils, responsibility must be fixed if effective health teaching is to occur.

Provision is made for teacher experimentation with various ways of developing health knowledge and health practices likely to be most successful in achieving the desired goals in a given school situation. Provision is also made for evaluating the pupils' health knowledge, health status, and health behavior at suitable times during the required teaching periods. Evaluation is to be concerned primarily with the practice aspects of the subject. It is recommended that pupils who have recognized but untreated defects, or who fail consistently in their social relationships, or who engage in unwholesome living practices, not be promoted or graduated.

Content for the junior high school and senior high school materials is divided into four major categories. These are: (1) Your Personal Inventory; (2) Your Personal Health; (3) Health in Your School, Home, and Community; and (4) Safety and First Aid in Your School, Home, and Community. These are developed separately and with entirely different suggestions for the junior and senior high school levels. In each of these separate developments the following pattern is used: (1) Introductory paragraph to stimulate interest and to indicate probable needs for the particular unit of work; (2) Objectives; (3) Basic information to be acquired; (4) Suggestions for initiating the unit; (5) Pupils' problems and activities; (6) Evaluation of outcomes; (7) References for teachers and for pupils. Teachers are urged to regard the materials as resource units and not to expect classes to follow the outline with exactness. Objectives are clearly, positively, and comprehensively stated for each unit. Suggestions for initiating the unit and the lists of proposed pupil problems and activities seem to contain in all cases a range of material which should enable individual teachers to exercise intelligent selection in terms of the needs of their particular pupil, school, and community situations. Suggestions for evaluation of outcomes go well beyond the mere pencil and paper type of testing which has often prevailed. References for teachers and for pupils are adequate and up to date.

If one subscribes to the basic philosophy of this Syllabus, namely, that good health teaching can be achieved only through separately organized courses, then it becomes an almost indispensable source of materials and suggestions for activities. Aside from this intended purpose, the Syllabus should prove very useful to all science teachers and others at either the junior or senior high school level who are concerned in any way with emphasizing health knowledge and health practices in their classroom work.

—NATHAN A. NEAL

Useful Sources for Science Teachers:

"Science Is Not Magic." Robert C. Hockett. Sugar Research Foundation, 99 Wall St., New York City. 8 p. March, 1945.

Reprint of an address delivered at a dinner in honor of Howard W. Blakeslee, Science Editor of Associated Press. An excellent discussion of the need for widespread popular understanding of science.

"Today's Ben Franklins." School Service, Westinghouse Electric Corp., 306 Fourth Ave., P. O. Box 1017, Pittsburgh 30, Pa.

One of the "Little Science Series" booklets, this is a presentation of the necessity to recruit scientific ability for modern research workers of the future. Depletion due to the War must be made up soon.

"Science, the Endless Frontier." Vannevar Bush. U. S. Government Printing Office, Washington, D. C. 184 p. July, 1945. 25¢.

This report to the President by the Director of the Office of Scientific Research and Development (O.S.R.D.) urges that the federal government institute and support a National Research Foundation with five divisions: Medical Research, Natural Sciences, National Defense, Scientific Personnel and Education, and Publications and Scientific Collaboration. The entire report is well worth careful study, but Chap. 4, "Renewal of Our Scientific Talent," is of special importance to science teachers.

"Serving Through Science." United States Rubber Co., 1230 Sixth Ave., New York City 20. 4 p.

A leaflet, issued weekly, reprints the radio talk given by an outstanding scientist on the New York Philharmonic Symphony program. Recent topics include: Anemia, Hybrid Corn, The Spectroscope, and Color Photography.

"Science for Life or Death." David Sarnoff. Radio Corporation of America, Rockefeller Center, New York City 20. 16 p. Aug. 10, 1945.

Reprint from the New York *Times* (above date), includes such headings as: Young Scientists Are Needed, Freedom of Science Is Vital, Science Moves Quickly, Unlocking Atomic Energy, Voice of Science.

"The Atom, New Source of Energy: A Tide in the Affairs of Men." McGraw-Hill Publishing Co., 330 West 42nd St., New York City. 8 p. 1945.

Here we have, with excellent diagrams, a concise statement on: How Atom-Splitting Releases Energy, Creating and Isolating the High-Power Atoms, Dollarwise Thoughts on Atomic Energy, What to Expect (and what NOT to expect) from Atomic Energy, and Peacetime Applications. Both informative and understandable.

"Atomic Energy for Military Purposes." Henry D. Smyth. U. S. Government Printing Office, Washington, D. C. 182 p. July 1, 1945. 35¢.

"A general account of the development of methods of using atomic energy for military purposes under the auspices of the United States Government,"—the scientific research and technical development that went into the making of atomic bombs.

The name, "Manhattan District," given by the War Department to the Atomic Bomb Project of the U. S. Corps of Engineers, is now familiar to many people. Here is the official report on that two-billion-dollar research.

Also available in book form from the Princeton University Press.

"The Atomic Age Opens." Gerald Wendt and others. Pocket Book Co., 1230 Sixth Ave., New York City 20. 252 p. Aug., 1945. 25¢.

An account which besides diagrams has portraits of a number of the scientists who contributed to our understanding and use of the atom, including, Einstein, Fermi, Meitner, Oppenheimer.

"Radar." British Information Services, 30 Rockefeller Plaza, New York City 20. 30 p. June, 1945.

A history of the development of radiolocation, especially the work of the scientist, Sir Robert A. Watson-Watt; its use in the Battle of Britain and by the R. A. F. and the British Navy, with clear explanation as to how radar works and a glossary.

Planes. Aircraft Industries Association (formerly, Aeronautical Chamber of Commerce) of America, 3324 Empire State Bldg., 350 Fifth Ave., New York City 1. 4 p. Monthly.

This publication contains news and other data concerning aviation, available in convenient form for possible use by science students and teachers.

"Of Men and Wings." United Air Lines, 80 East 42nd St., New York City. 32 p. 1945.

General information about aviation; many illustrations.

M. E. O.

KENNEDY, JEAN. *Here Is India.* New York: Charles Scribner's Sons, 1945. 154 p. $2.75.

India, one of the most fascinating and mysterious countries of the world, is rapidly becoming one of our problems. This is a truly fine book and the author makes one feel that she knows and "feels" India.

The author was born in India of missionary parents, her mother being British, her father American. She went to school and college in this country, but returned to India to teach. Her husband is a professor at Yale and recently she has taught Indian geography and history at the University of Pennsylvania.

Many fine photographs supplement the textual material which is so excellently written. This is an excellent book for the general reader as well as the student in geography.

—F.M.D.

GRINTER, L. E. ET AL. *"Engineering Preview."* New York: The Macmillan Company, 1945. 581 p. $4.50.

This book is intended either for the last year of high school or the first year of college. It is an introduction to engineering, including the necessary review of science and mathematics. Sciences considered are physics and chemistry. Student counsellors will find the book helpful.

C. M. P.

NEWMAN, CAPTAIN Q. B. *Marine Electric Power.* New York: Simmons-Boardman Publishing Company, 1945. 244 p. $2.50.

Captain Newman's book on Marine Electric Power will be welcomed by seamen, navy yard and marine workers, for the rapidly increasing use of electricity on shipboard within the last decade has created a real need for a source of information for the average individual not too well grounded in physics and mathematics.

—G.O.

BINGER, CARL. *The Doctor's Job.* New York: W. W. Norton and Company, 1945. 243 p.

Branches of study which are "elective" because they are not of general value come in time to be "required" because their products prove to be of general importance. In the meanwhile, however, the extreme specialization that accompanies training for research threatens to disrupt the intellectual unity of those who become experts. Dr. Binger, who himself spent many years in research, reflects on the problems of the practical physician who sees the specialties outrun his capacity to keep up with research. Science teachers may gather from Dr. Binger's experiences and observations the hope that further developments will lead to fuller integration of both the "studies" and the eventual services of the experts.

Teachers of biology, physics and chemistry drew considerable satisfaction from the recognition accorded their subjects when these became prerequisites for admission to medical schools in the years preceding the first World War. In the competition among the several "disciplines" for position in the high school or college curriculum, these teachers naturally emphasized the practical applications that other people might make of their facts and principles. And medical students were being more intensively trained in the details of cells, the chemistry of metabolism, the mechanics of the various organs and of their processes. But as "scientific" details multiplied, students found their attention increasingly dissipated; and nobody was responsible for directing their concerns and insights toward the whole person who might eventually present himself as "patient."

In the training of engineers and even of teachers a similar isolation of countless details from the various specialties operated to isolate the expert from all concern with the living humans in their very complex interrelationships—which alone gives meaning to all our efforts. Dr. Binger's book should help science teachers with his clear exposition of the process by which a master of several specialties gradually discovers that his major practical task is to acquire insight into the whole human being whom the teacher, as well as the physician, is called upon to understand and guide. It is of value even for teachers who have no interest in medicine or in the biological sciences but who are genuinely concerned with the students—each of whom has to be understood as a whole person. For like the physician, the teacher has to use what he has learned so that the separate "fields" illumine one another and so that the students get from their efforts help in integrating their world and themselves—in becoming whole.

—BENJAMIN C. GRUENBERG.

KENOYER, LESLIE A. AND GODDARD, HENRY N. *General Biology.* New York: Harper and Brothers, 1945. 653 p. $4.50.

This is the revision of a text published eight years ago. It represents a complete revision and the inclusion of much new material. There are many illustrations to illustrate the outstanding biological principles. Questions and references are found at the end of each chapter. There seems to be a satisfactory emphasis between the animal and plant aspects of biology.

—R.J.

MILLARD, NELLIE D. AND KING, BARRY G. *Human Anatomy and Physiology.* Philadelphia: W. B. Saunders Company, 1945. 514 p. $3.00.

This seems to be an unusually good elementary text in anatomy and physiology. There are 296 illustrations, several of which are in color, and good chapter summaries. This college text would serve as an excellent reference for high school biology and physiology teachers.

—R.J.

HENNEY, KEITH. *Principles of Radio.* New York. John Wiley and Sons, Inc., 1945. 534 p. $3.50.

The first edition of this book appeared fifteen years ao. The original viewpoint of a text for the student with little background in radio has been maintained. Much new material has been added. Previous editions of the text have been used more widely, probably, than any similar book in the field. The author is the well-known editor of "Electronics."

—S.A.

ALICO, JOHN. *Introduction to Magnesium and Its Alloys.* Chicago: Ziff-Davis Publishing Company, 1945. 183 p. $5.00.

This is the most comprehensive work that has been published on magnesium. Magnesium metal for structural purposes became a leading strategic material in the early days of World War II and its production increased more than a hundredfold. Fundamentals of production and fabrication are covered.

—S.A.

SHIPPEN, KATHERINE B. *New Found World.* New York: The Viking Press, 1945. 262 p. $3.50.

This is a colorful, delightfully interesting survey from earliest times to the present of the vast region that stretches from Mexico to Tierra del Fuego. Science, geography, and history are interwoven into an unusually appealing story of our good neighbors to the South. Both adults and high school students will enjoy the many interesting facts and comments about a land and people about which we really know so little, yet whose destiny is so closely bound up with ours. The stories of the ancient civilizations of the Aztecs, Incas, and the Mayas, the voyages of Columbus and of the heroes and peoples of the various South American countries are most interestingly told.

—F.M.D.

STINETORF, LOUISE A. *Children of South Africa.* Philadelphia: J. B. Lippincott Company, 1945. 175 p. $2.00.

Both boys and girls of junior high school age will enjoy the stories of everyday life and adventures of the dozen boys and girls of South Africa described in the book. It is recommended as a supplementary reader in geography and as a book of general interest to "teen" age boys and girls.

—F.M.D.

MODAK, MANORAMA R. *The Land and the People of India.* Philadelphia: J. B. Lippincott Company, 1945. 109 p. $2.00.

Physical science and natural science, as well as geography, teachers can learn much they never knew about that great country, India, and its people. It is authoritatively and interestingly written.

So shut in from the rest of the world, India is almost an island. It is the land of the monsoon and the activities, products, as well as the social and economic life of the people, are controlled by it. Their great day of celebration, *Coconut Day,* comes near the middle of August to mark the end of the rainy monsoon season.

The civilization of India dates back to before 3000 B.C. It is believed they migrated into India from the west through Afghanistan passes. With more than three times the population of the United States, the many nationalities and languages, the caste and religious systems present problems whose solutions will vitally affect the rest of the world. Science, technology, and industrialization have made only a relatively small beginning. The author, American born, principal of a girls' high school in India, and wife of a prominent Indian leader, is to be congratulated upon writing such an excellent book.

—F.M.D.

SYMPOSIUM. "The Future of Industrial Research." New York: Standard Oil Development Company, 1945. 173 p.

The Forum recorded in this volume was an effort, perhaps the most serious up to this time, to obtain a wide cross-section of qualified opinion on the future of industrial research.

The demonstrated capacity of the nation for production and service is far above the prewar level. The new factor which formed the basis for this result is technological progress and its engineering applications. The progress in turn resulted more from industrial research than any other single factor. The most important immediate problems are training more research specialists.

Contributions to this treatise have been made by numerous industrial and research leaders. Among these leaders are: Frank A. Howard, C. F. Kettering, Frank K. Jewett, Thomas Midgley, Jr., Harry L. Derby, Bradley Dewey, Earl P. Stevenson, Edwin H. Land, Warren K. Lewis, Westbrook Steele, Clyde E. Williams, Lyman J. Briggs, and Lammont DuPont.

Science teachers and business laymen interested in industrial development will find this a challenging book.

—C.M.P.

GRIMES, CHARLES W. "A Story Outline of Evolution." Boston: Bruce Humphries, Inc., 1945. 244 p. $2.00.

Two aspects of evolution are considered in this treatise: cultural and organic. It is a simple, direct presentation by one who believes that Evolution is Nature's working out of the Creative Plan. It is a layman's account, readable and devoid of technical phraseology.

It is an excellent book for the high school student, science teacher, and laymen. It has been recommended by the journals Religious Education and Catholic School Journal.

—C.M.P.

ATKINSON, CARROLL. "True Confessions of a Ph.D."; "Pro and Con of the Ph.D." Boston: Meador Pubishing Company, 1945. 88 p., $1.00; 172 p., $2.00.

These two books really supplement each other and could have been confined very appropriately in a single cover. Both those who are working on the doctorate (or contemplate doing so) and those who have completed it, will find

many phases enjoyably reminiscent and others challenging.

In *True Confessions,* Dr. Atkinson presents some of his emotional and mental reactions to his schooling process, starting at the elementary level and ending with the awarding of the doctorate. The second part written seven years later presents his later thinking on the doctorate degree and some recommended changes in its requirements.

In "Pro and Con," the historical background of the Ph.D. degree and its requirements is discussed. Present college and university practices in awarding various degrees are examined at some length.

Various requirements of the Ph.D. degree such as the preliminary examination (oral and written), the foreign language requirement, residence requirements, credit requirements, and the final oral are all discussed as to values and inadequacies. Many citations are articles in professional magazines. Seemingly there is agreement in the belief that the Ph.D. requirements are in need of reform. There is much less agreement as to the direction that these reforms should take. Dr. Atkinson lists several that he believes should be made. These would alter practically all present requirements, many radically. In general, he believes there should be a definite increase in the standards of attainment for those receiving the doctorate—a better selection and screening of candidates and higher standards of workmanship during the graduate period. Both the quality of the written product and the doctorate himself should be superior to the present output.

—C.M.P.

MCCLINTOCK, MARSHALL. *The Story of War Weapons.* Philadelphia: J. B. Lippincott Co., 1945. 173 p. $2.50.

This is a rather comprehensive introduction about the history and use of war weapons. It traces the story of man's weapons from the clubs used by cave men to the bazookas, rockets and jet bombs of today. Included are descriptions of the Maginot Line and other defenses and offenses used in World War II. Eighty linecuts make details of construction and operation clear. A glossary of common military terms is given at the end. Boys will be especially thrilled in reading this book.

—S.A.

STOMMEL, HENRY. *Science of the Seven Seas.* New York: Cornell Marimtime Press, 1945. 208 p. $2.50.

Science of the Seven Seas offers little bits of interesting information and comments about many phases of natural phenomena—the sea (waves, ovean bottom, nature of sea water, tides, ice, currents, shores and islands), the sky (atmospheric optical illusions, the upper air, fogs and clouds, the winds, lightning, and celestial bodies), and ocean life.

This is a popular book that is recommended for the secondary science library.

—S.A.

LEGGETT, WM. F. *The Story of Linen.* New York: Chemical Publishing Company, Inc., 1945. 103p. $2.75.

This enjoyable book meets not only the hopes of the publisher that it will be of interest to those concerned with the development of textile materials but it offers to the lay reader a delightful yet authentic history of linen as well as an understanding of the habits and culture of ancient peoples as they developed early textile materials.

—G.O.

HENRY, MARGUERITE. *Robert Fulton.* Indianapolis: Bobbs-Merrill Company, 1945. 187 p. $1.50.

This is another book in "The Childhood of Famous Americans Series," and a fascinating book it is revealing as it does the boyhood of Robert Fulton, the inventive young Bob and his friend the gunsmith. Even though he was twelve, his head was full of ideas. A true craftsman he was. When the book opens he is moulding a candlestick for his mother's birthday. We see him making his own ink from copperas and vermillion and a "lead" pencil from a rock in Conestega Creek and a paint brush from the tail of Matilda the cat. He collected pewter and repaired rifles and designed new ones during the Revolutionary War. His meeting Benjamin Franklin is one of the exciting moments of the book. And, of course, we must be sure to read about his sky rockets and paddle wheel boats. The delightful home life of the five little Fultons depicted here makes this book a "must" in the home as well as the school library. Lawrence Dresser's black and white illustrations make the book very attractive.

—G.O.

BAYNE, C. S. *Getting to Know the Birds.* New York: Wm. Collins Sons and Co., 1944. 102 p. $2.50.

This is truly a delightful book with special appeal for the junior high school or biology pupil. The author is a well-known English nature writer, and in this book he contributes many charmingly simple anecdotes about some birds he has observed.

No less important than the descriptive material are the fine color portraits by Ralston Gudgeon. He has also made several little pencil sketches which are scattered throughout the book.

Among the birds described and in portrait are: the robin, blue tit, great tit, blackbird, song thrush, starling, wren, swallow, chaffinch, cuckoo, pied wagtail, grey wagtail, kingfisher, skylark, spotted flycatcher, yellow hammer, reed bunting, brambling, and redstart.

—C.M.P.

POLLACK, PHILIP. *Careers in Science.* New York: E. P. Dutton and Company, Inc., 1945. 222 p. $2.75.

This is one of a long series of Career Books published by Dutton. A number of these have related to specific sciences or phases of science. A careful reading ot these books would be of great value to practically every high school boy and girl, as it would enable him or her to select a particular future vocation much more intelligently and wisely.

Careers in chemistry, physics, biology and geology are described. There is a special chapter on "A Woman's Place Is in the Laboratory." There are two interesting chapters by Dr. Albert W. Hull, Assistant Director of the General Electric Research Laboratory, and Charles F. Kettering, Vice-President and Director of Research of the General Motors Corporation.

—C.M.P.

METCALFE, JUNE M. *Copper, the Red Metal.* New York: The Viking Press, 1944. 104 p. $2.00.

Copper is probably the metal used longest by man, its first use going even back to the cave man. And today it ranks as one of the most important metals used by modern industrialized society. *Copper, the Red Metal* is a most fascinating, readable account of one of man's treasures. The author traces the story of copper from its geological origin, through the various mining and metallurgical processes to the finished product.

The book is written in a most interesting style, with highly technical details omitted. Many excellent photographs supplement the textual material. No finer book could be added to the high school science library. It is most highly recommended as a supplementary book for the chemistry course.

—C.M.P.

SHULER, ELLIS W. *Rocks and Rivers of America.* Lancaster: The Jaques Cattell Press, 1945. 300 p. $4.00.

Few, if any, better books have been written in popular geology. Indeed, the reviewer knows of none. For some reason there has been a less number of popular books written in geology than in any other science field. *Rocks and Rivers of America* is written from the cultural point of view. Yet, it elucidates many geological principles and at times dips into the field of scientific speculation. The book is richly illustrated with more than a hundred photographs of notable landscapes and illustrative types of geological phenomena. The quality of paper is unusually fine and adds much to the attractiveness of the book.

The literary style is a happy blending of scientific accuracy and detail, with down-to-earth language. The author is Professor of Geology and Dean of the Graduate School of Southern Methodist University. He has traveled widely and is a noted classroom teacher.

—C.M.P.

ABSTRACTS

ANONYMOUS. "Many Habitable Worlds." *Science News Letter.* 47:402, June 30, 1945.

According to Dr. Henry Norris Russell, noted Princeton University astronomer, life may exist on thousands of planets among the millions of small dark companions of bright stars throughout the universe. Outside the system composed of our sun and its circulating planets, there was no evidence for the existence of other planets till within the last three years. But among the nearer bright stars there is now evidence of invisible companions revolving about the stars, making them move in slightly wavy curves. Surely life is possible and even probable on these planets and in various stages of development. Some is likely much more primitive than that on earth and some surpassing mankind in intelligence and character.

GRIGGS, ROBERT F. "Biology and Agriculture in the Postwar World." *Science,* 101:235–239, March 9, 1945.

This is an address made before the Botany section of the A.A.A.S. and the Botanical Society of America. Biologists have not measured up either to their opportunities or to their responsibilities in contributing to the war effort. But there is every indication that the biological sciences will assume a more important role in public service in the postwar world. The biologists need to educate the public as to what it needs in the way of service from the biological science and of the services now available. The primary need of our sciences is for permanent organizations of skilled people to carry on this work of public education.

BORLAND, HAL. "We Move the Earth for Copper." *Popular Science Monthly,* 146:122–127, March, 1945.

Copper has always been a prime necessity of war. The biggest of all copper mines, both in area worked and in ore handled is that at Bingham, Utah. Since 1904 this mine has yielded some six billion pounds of copper. (This mine is also the second largest producer of molybdenum in the world.) Arizona ranks first among the states in copper production, followed by Utah, Montana, Nevada, New Mexico and Michigan in that order. World production in 1943 in tons

was as follows: United States 1,110,000, Chile 550,000, Canada 290,000, Germany negligible and the rest of the world 1,130,000. Brief description of the mining process at Bingham and the three principal ways of handling copper ores are included.

THONE, FRANK. "War's Fireworks." *Science News Letter*, 47:409–410, June 30, 1945.

Brighter skies are predicted for future Fourth-of-July displays. Pyrotechnics have been widely used and greatly developed in this war. Flares and aerial bombs, white phosphorus, and tracer ammunition and colored smoke in rainbow colors have had extensive usage. Colored smokes in technicolor will see much after-the-war usage, phosphorus and tracer ammunition will be of very limited use.

MORROW, MARTHA G. "Oil, Mother of Chemicals." *Science News Letter*, 48:26–27, July 14, 1945.

Advances recently made in the petroleum industry will result in better postwar cosmetics, plastics, insecticides, and automobiles. Flaming jellied-gasoline has been responsible for the rapid progress made in the Japanese war and at the same time has resulted in the saving of countless American lives.

ANONYMOUS. "Metals Float Above Gas." *Science News Letter*, 47:405, June 30, 1945.

Increased light efficiency of the 100-inch Mt. Wilson reflector, due to faster photographic plates and to optical apparatus of improved design, has enabled astronomers to confirm and expand a hypothesis advanced half a century ago that cool metallic clouds of iron, vanadium and titanium float above hot hydrogen gas surrounding some stars.

ANONYMOUS. "Heartbeats Counted." *Science New Letter*, 47:101, February 17, 1945.

The heartbeats of birds are usually considerably greater than that for man and can be speeded up terrifically under conditions of excitement and exertion. Basal and maximum rates of some birds are: dove, 135 and 570; cardinal, 445 and 810; English sparrow, 350 and 902; chirping sparrow, 440 and 1060. Basal rate for ruby-throated humming bird, 615.

THONE, FRANK. "National Emblems." *Science News Letter*, 47:410–411, June 30, 1945.

The bald eagle is a national emblem as part of our national Great Seal and as a device on many of our coins. Benjamin Franklin backed up by the great naturalist, Audubon, once offered good arguments to make the wild turkey our national bird. Other emblems that would be of distinction would include the bison or American buffalo, the golden rod, columbine, and the American elm.

MEISTER, MORRIS. "What Kind of Science Club; Effective Work in Science Clubs; Starting a Science Club; Science Club Meetings; Equipment for the Science Club; and Cooperating Science Clubs." *The Science Class-Room*, 44:1 and 4 of various issues. December, 1944. January, February, March, April, and May, 1945.

The above indicated titles on various phases of science club work have appeared in successive issues of *The Science Classroom*. Each article is illustrated and is based upon the long experience of America's outstanding authority on science club work.

CLARK, HAROLD F. "Experiments in the Social Sciences." *Science*, 101:393–398, April 20, 1945.

This is the address of the vice-president before the Education section of the A.A.A.S. Experiments in the social sciences are not only possible but many are being carried out. The Sloan Foundation is conducting a series of such experiments on a very large scale. Scientific techniques can be applied in the social field. Admittedly, it is quite true that experimentation in the social sciences cannot be conducted in the narrow and rigid way that the laboratory scientist does. Dr. Clark cites several rich fields for social experimentation—diet, drinking water, housing, governmental organization, conservation and so on.

HULL, ALBERT W. "Selection and Training of Students for Industrial Research." *Science*, 101:157–150, February 16, 1945.

This is the vice-presidential address before the Section for Physics of the A.A.A.S. The author is a member of the research laboratory of the General Electric Company. The four qualities needed for success in industrial research in order of importance are: character, aptitude for research, attitude toward work, and knowledge.

KLOPSTEG, PAUL E. "Increasing the Productivity of Research." *Science*, 101:569–575, June 8, 1945.

The author states that "Research is original and creative intellectual activity carried on in the laboratory, the library or in the field which endeavors to discover new facts and to appraise and interpret them properly in the light of previous knowledge. With constantly increasing understanding, it revises previously accepted conclusions, theories and laws, and makes new applications of its findings. Whether it seeks to extend knowledge for its own sake or to achieve results with specific economic or social value, its raison d'etre is its contribution to human welfare." At some length, the author elaborates the theory that the ideal situation for research is a department of applied science with its laboratories of instrumentology.